



Monitors and  
Mass Storage

# Service Guide

October 1992

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## **Introduction**

The *Monitors and Mass Storage Apple Service Guide* is the fourth in a series of supplemental booklets that help Apple-certified technicians troubleshoot and repair Apple products at customers' sites. The *Apple Service Guide* series contains information condensed from a number of Apple Service products and sources; it includes only need-to-know information for the experienced technician. These guides do NOT replace the Apple *Service Source CD*.

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## **Organization**

The *Monitors and Mass Storage Apple Service Guide* contains the following chapters and sections:

**General Monitor Information** – This chapter contains vital information that you must understand before you service any monitor, including:

- Environmental display distortions
- Diagnostics and video cables
- Safety and ESD

**Monochrome and Color Monitors** – The monitor sections contain information specific to eleven Macintosh monitors. Each monitor section has four parts:

- Illustrated parts list
- Symptom/cure troubleshooting
- Safety instructions
- Adjustments

**Macintosh Video Cards** – Information on all Macintosh video cards is in this chapter.

- Illustrated parts list
- Built-in and NuBus video compatibility and output
- Video upgrade and troubleshooting

**General SCSI Information** – This chapter contains key background information on Apple SCSI devices.

- SCSI requirements and quick reference information
- How to troubleshoot and correctly terminate SCSI chains

**Hard Drives** – This chapter includes information on:

- Parts list for hard drives and most associated parts
- Carrier compatibility and return configuration
- Checklist, symptom/cure, and flowchart troubleshooting
- SCSI select jumper configurations and startup problems

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Floppy Drives – Information in this chapter includes:

- Parts list for floppy drives and most associated parts
- Internal cable and carrier compatibility matrix
- Cleaning information
- Removing disks that will not eject
- Logic board upgrade procedures for the SuperDrive
- Checklist and symptom/cure troubleshooting

CD ROM Drives – This chapter includes:

- Illustrated parts list
- Symptom/Cure troubleshooting

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## How to Use This Guide

This guide is designed to present consolidated technical information clearly and directly. Knowing some of the basic format rules can help you use the guide effectively.

- The name of the product chapter is on the bottom-right corner of every left page (e.g., "Preface" below).
- The name of each section of the product chapter is at the top of the first page of the section (e.g., the title "Introduction" on page v).
- The definitions of Notes, Importants, Cautions, and Warnings appear below.

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### Definitions of Alerts

**Note** A note adds emphasis or clarity.

**Important** **An important highlights practices that could cost you significant time or trouble.**

**▲ Caution** **A caution signals danger to the equipment.**

**▲ Warning** **A warning signals danger to YOU!**

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# General Monitor Information



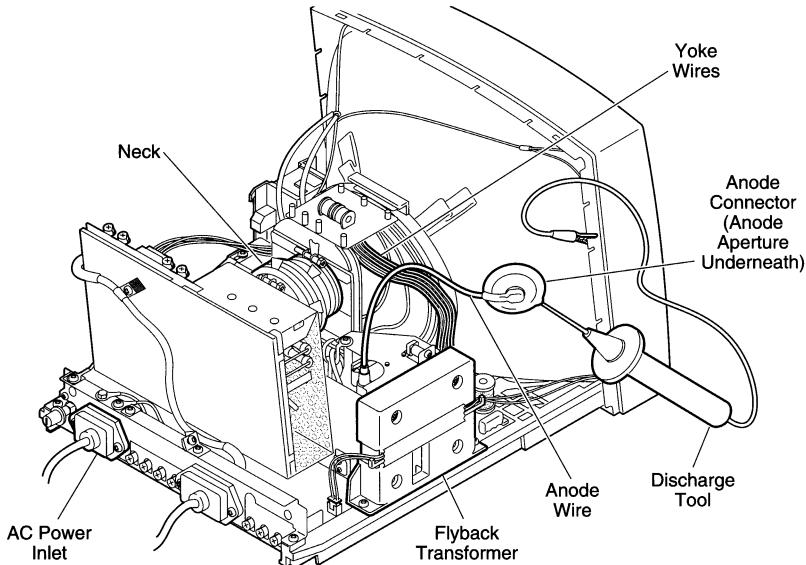
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## Safety Information

### Ten Rules to CRT Safety

Cathode-ray tube (CRT) monitors are dangerous. Use the following safety rules to avoid injury when working on Macintosh monitors.

1. **Do not work on a monitor alone.** In case of an accident, having someone nearby—and having someone trained in CPR—could save your life.
2. **Remove all jewelry before performing repairs on a CRT.** Removing these conductors reduces the possibility of electric shock.
3. **Never use a grounding wriststrap or heelstrap or work on a grounded workbench mat when discharging a monitor or when performing live adjustments.**
4. **Wear safety goggles when working with a CRT.** The CRT contains a high vacuum. If cracked or broken, the CRT can implode (collapse into itself). To protect your eyes, always wear safety goggles.
5. **Before working inside a monitor, turn off the power and disconnect the external power cord.** Certain parts of a monitor chassis are hot (electrified) when the monitor is under power. Never work on a monitor under power except when making live adjustments.
6. **Keep one hand in your pocket or behind your back when working on a live monitor.** This reduces the risk of current passing through your body, should you accidentally contact high voltage.
7. **FIGURE 1. Always discharge the anode before touching anything inside the monitor.** High voltage (up to 12,000 volts DC) can be present on the anode and other components—even when power is off.
8. **Never touch the anode connector or the anode aperture.** When a CRT is replaced, the anode connector is removed, exposing the anode. The anode can retain a charge of several thousand volts even when power is off and can regain some charge even after discharge.
9. **FIGURE 1. Do not pick up or handle a CRT by the neck.** To prevent an implosion, take every precaution against breaking the tube. Be especially careful with the neck, where the tube is thinnest.
10. **FIGURE 1. When adjusting a live CRT, never touch any of the components shown in the figure.**



**Figure 1 CRT Discharge and Danger Points**

### **Discharging the CRT**

**▲ Caution** **Discharge the anode to the metal part of the bezel. Failure to do so will damage the logic board.**

1. Remove your grounding wriststrap and jewelry, and put on safety goggles.
2. FIGURE 1. Attach the alligator clip on the CRT discharge tool to the metal part of the bezel.
3. FIGURE 1. Put one hand in your pocket or behind your back. With your other hand, insert the tip of the CRT discharge tool under the anode cap until it touches the anode ring.
4. Remove the CRT discharge tool. To be sure that the CRT is discharged, repeat the discharge procedure (you may want to repeat the procedure using a flat-bladed screwdriver with an insulated handle).

**▲ Warning** **The anode can build up voltage over time. To drain off any residual charges, establish an ongoing ground. Fasten one end of an alligator lead to the metal part of the bezel and the other end to the anode aperture.**

---

## **Disposing of the CRT**

To prevent serious injury, follow the procedure described in this section whenever you discard a CRT.

**▲ Warning** **To properly dispose of a defective CRT, you must first devacuum the cathode-ray tube. Discarded CRTs that have not been devacuumed may crack and implode, injuring anyone who happens to be near.**

---

### **Materials Required**

Thick cardboard box large enough to conceal the CRT

Large, sharp diagonal cutters

Large pliers and duct tape

Safety goggles and gardening gloves

12" x 12" piece of cloth or heavy paper

1. Put on safety goggles.
2. In the side of the box, cut a hole just large enough to insert the tip of the CRT neck.
3. FIGURE 2. Place the CRT inside the box with the tip of the neck protruding through the hole, and tape the box flaps down with the duct tape.

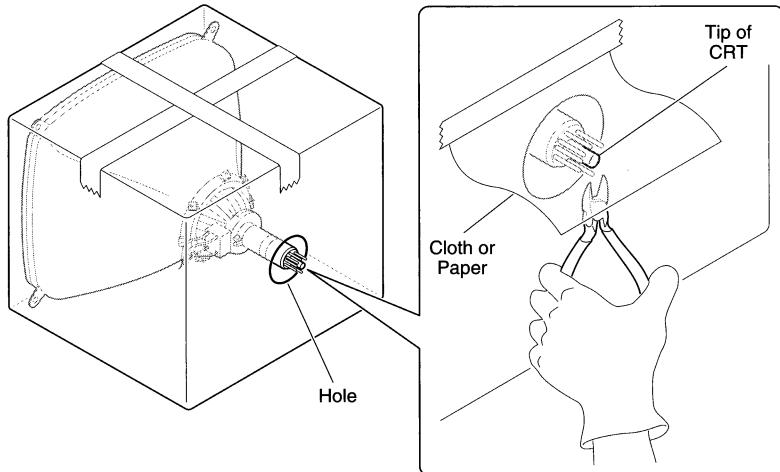
**▲ Warning** **Only the very tip of the CRT neck should be protruding through the hole in the box, and the box must not have any other opening.**

---

4. FIGURE 2. Put on gloves and, using the diagonal cutters, carefully clip off the connector pins on the end of the CRT neck.
5. FIGURE 2. Tape the piece of cloth or paper onto the box so that it forms a veil over the opening, but allows access to the tip of the CRT. The purpose of the veil is to catch bits of glass that may fly during the next step.
6. Make sure that no one is standing nearby. Then stand to one side, reach under the veil, and with the large pliers grasp the exposed tip of the CRT. Look away while you snip off the tip of the CRT.

---

You will probably hear a rush of air entering the CRT when the CRT vacuum breaks—but even if you don't, the procedure is complete if the tip of the CRT is clearly broken off.



**Figure 2 Devacuuming the CRT**

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## **ESD Prevention**

Electrostatic discharge (ESD) can irreparably damage the sensitive chips and printed circuitry of electronic components. Plastic utensils, foam cups, polyester clothing, and even the ungrounded touch of your hand carry sufficient electrostatic charges to damage electronic components. Follow the ESD prevention rules and procedure below to prevent ESD damage.

---

### **ESD Prevention Rules**

1. Before working on a device containing a printed circuit, ground yourself and your equipment. Use a grounded conductive workbench mat and a grounding wriststrap, and ground your equipment to the mat.

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#### **▲ Warning**

#### **Make certain that you are NOT grounded when:**

- **You work on plugged-in equipment**
- **You discharge a cathode-ray tube (CRT)**
- **You work on an unplugged CRT that has not been discharged**

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2. Do not touch anyone who is working on integrated circuits. You could "zap" the equipment through the technician—even though the technician is grounded.
3. Use static-shielding bags for boards and chips during storage, transportation, and handling. Leave all Apple service components in the ESD-safe packaging until you need them.
4. Handle all ICs by the body, not the leads. Also, do not touch the edge connectors or exposed circuitry on boards or cards.
5. Do not wear polyester clothing or bring plastic, vinyl, or Styrofoam® into the work environment. The electrostatic field around these nonconductors cannot be removed.
6. Never place components on any metal surface. Use antistatic, conductive, or special foam rubber mats.
7. If possible, keep the humidity in the service area between 70% and 90%, and use an ion generator. Charge levels are reduced (but not eliminated) in high-humidity environments and in areas with ion generators.
8. If an ESD pad/workstation is not available, plug in the computer and touch the bare metal on the power supply to discharge electrostatic charges.

---

## **Setting Up an ESD-Safe Workstation**

### **Materials Required**

Conductive workbench mat with ground cord  
Wriststrap with built-in 1-megohm resistor and ground cord  
Equipment ground cord with alligator clips  
Ground/polarity tester

1. Remove all ESD hazards from the area. Nonconductive materials (see rule #5 above) cannot be grounded and can retain charges for hours and even days.
2. Use a ground/polarity tester to verify proper grounding of the power outlet. If the outlet is wired incorrectly, most testers show a light pattern that matches a code given on the tester. If the tester does not verify proper grounding, move to another outlet that is safe.
3. Connect the ground cord. Fasten it to the workbench mat and to the wriststrap. The metal on the wriststrap should touch your skin.
4. Finally, ground the equipment that you are working on. Use alligator clips and a grounding cord to attach any metal part of the device you are working on to the grounded workbench mat.

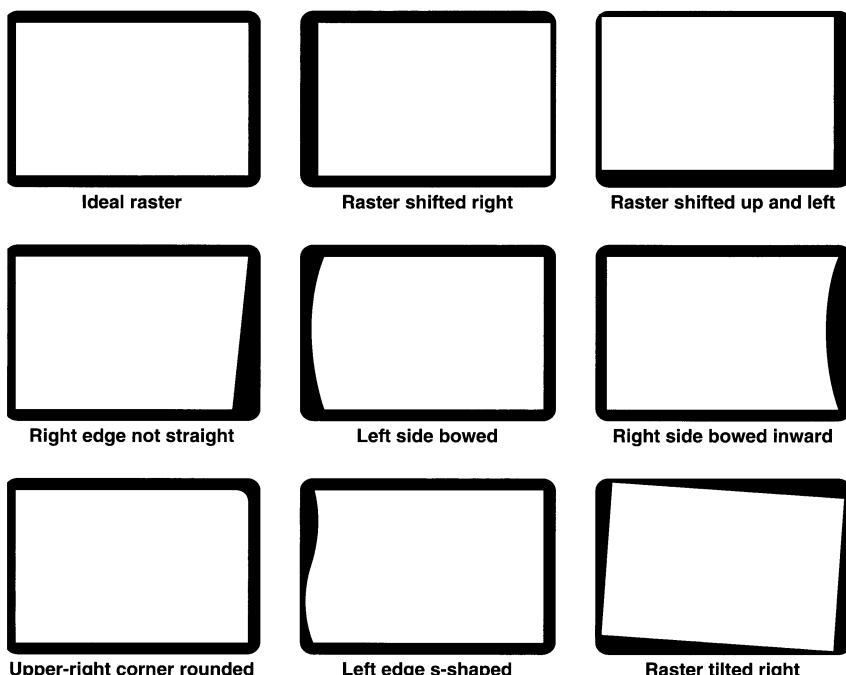
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## Environmental Display Distortions

### Monitor Distortion

Environmental distortion (see FIGURE 3) is especially noticeable on large-screen monitors. Even monitors set to factory specifications may appear distorted when set up in a new environment. This problem affects all monitors and is not specific to Apple monitors.

If you encounter a monitor with geometric raster distortions like those shown in FIGURE 3, check first for environmental causes before attempting to repair or adjust the monitor. Try swiveling or moving the monitor to another location, and note any changes in the display. If possible, the best test is to remove the monitor from the building and recheck the display in an entirely different location. If the display changes (for better or worse) when you swivel or move the monitor to another location, the environment is the source of the problem.



**Figure 3 Distortion Problems Often Caused by Environmental Conditions**

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Keep in mind that module swapping cannot fix a monitor with environmental distortion problems, and that adjusting a monitor with environmental distortion problems alters the factory settings. You may be able to adjust a monitor to compensate for an unfriendly environment, but if your customer moves the monitor to another location the resulting geometric distortion could be much worse because the monitor is no longer set to factory specifications.

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## **Environmental Influences**

The following types of raster distortion by environmental conditions are common:

- **Static Raster Distortion**, which distorts the position, size, or shape of the screen image, may be caused by
  - The Earth's magnetic field. Rotate or move the monitor to another location. (Earth magnetism usually distorts only the edges of the screen and does not affect the active or working area of the screen.)
  - Proximity to metal objects, which impact the surrounding magnetic field. Metal desks, file cabinets, and book shelves can distort the raster. Remove the metal objects or rearrange the office.
- **Dynamic Raster Distortion**, which causes movement or "jitter" of the screen image, may be caused by fluorescent lights, other monitors, copy machines, or electronic appliances such as coffee makers and refrigerators. Switch off and unplug these items or move them further away from the monitor.

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## Diagnostics

Use the following table to determine the correct diagnostic and diagnostic modules for displaying monitor test patterns. When testing monitors with *MacTest™ Pro*, use the Monitor Test Patterns module and either the Video Card module (for testing via NuBus™ only) or the appropriate CPU module.

Monitor Diagnostics	
Systems Tested Via the NuBus Connector	Diagnostic to Use for Generating Test Patterns
Macintosh II, IIx, IIfx, IISI, IIcx, IIci, Quadra 700, 900, 950, Performa 400 and 600	Diagnostic: <i>MacTest Pro</i> Disk: Video Cards
Systems Tested Via the Built-in Video	
Macintosh LC, LC II, Performa 400 and 600	Diagnostic: <i>MacTest Pro</i> Disk: Macintosh Classic II, LC, LC II, IIvi, Performa Family
Macintosh IIci	Diagnostic: <i>MacTest IIcx/IIci</i> Disk: <i>MacTest IIcx/IIci</i>
Macintosh IISI	Diagnostic: <i>MacTest MP</i> Disk: <i>MacTest MP</i>
Macintosh Quadra 700, 900, and 950	Diagnostic: <i>MacTest Pro</i> Disk: Macintosh Quadra
PowerBook 160 and 180	Diagnostic: <i>MacTest Pro</i> Disk: Macintosh PowerBook

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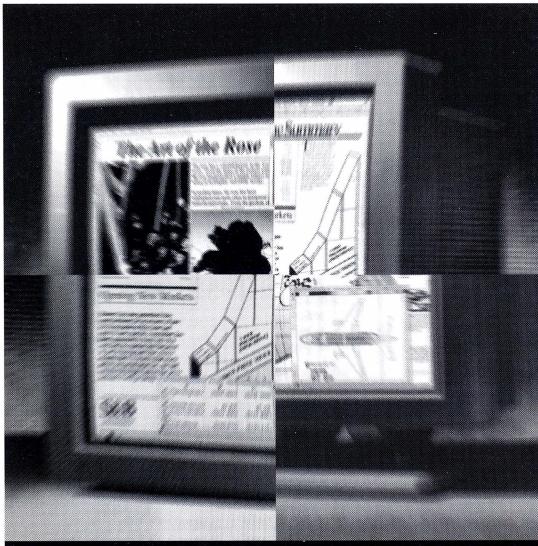
## Video Cables

Use the following table to determine compatible monitors and video cables.

Video Cables	
Video Cable	Monitors
590-0161 DA-15 to DA-15 Length: 1 m	Apple High-Res Mono. Monitor AppleColor High-Res RGB Monitor
590-4161 DA-15 to DA-15 Extended length: 1.75 m	Apple High-Res Mono. Monitor AppleColor High-Res RGB Monitor
590-4510 Permanently attached to the monitor	Macintosh 12-Inch Mono. Display
590-0693 Permanently attached to the monitor	Macintosh 12-Inch RGB Display
922-0035 Permanently attached to the monitor	Macintosh Color Display
590-0734 Permanently attached to the monitor	Macintosh 16-Inch Color Display
590-0574 11-pin mixed connectors (DB-25 size) For original Mac II Portrait Display video card (661-0604)	Apple Mac Portrait Display Apple Mac Portrait Display "Series B"
590-0615 DA-15 to 13-pin mixed connector (DB-25 size)	Apple Mac Portrait Display Apple Mac Portrait Display "Series B" Apple Two-Page Mono. Monitor Macintosh 21-Inch Color Display
590-0562 13-pin mixed connectors (DB-25 size)	Apple Two-Page Mono. Monitor
590-0831 Adapter, 14-pin video connector to DA-15 For use with PowerBook 160 and 180	Macintosh 12-Inch Mono. Display Macintosh 12-Inch RGB Display AppleColor High-Res RGB Monitor Macintosh Color Display Apple Mac Portrait Display Macintosh 16-Inch Color Display



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Monochrome Monitors

# **Apple High-Res Monochrome Monitor**



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## Illustrated Parts List

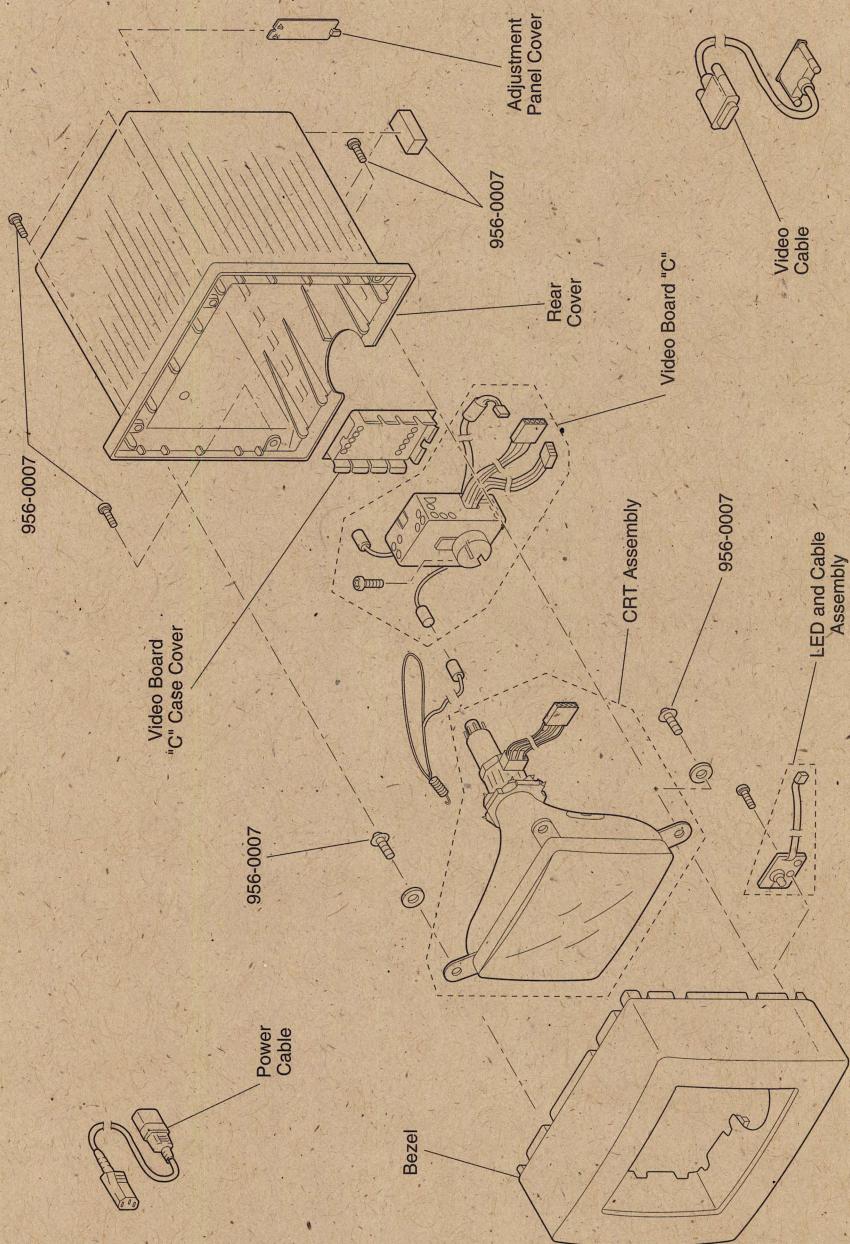
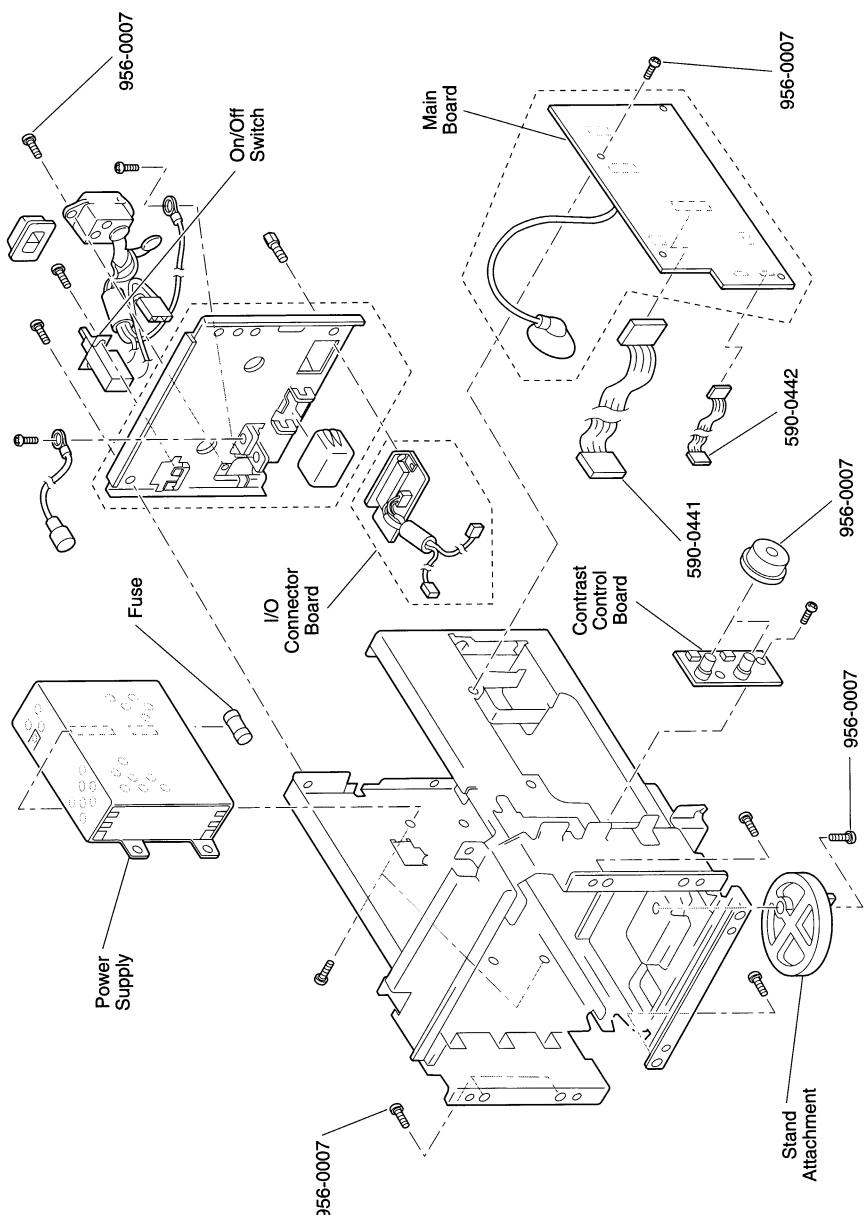


Figure 1 High-Res Monochrome Monitor Exploded View



**Figure 2 High-Res Monochrome Monitor CRT Exploded View**

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Cables	
Cable, external power, domestic .....	590-0372
Cable, external power, Europe.....	590-0422
Cable, LED assembly.....	590-0440
Cable, main board to control panel .....	590-0442
Cable, main board to power supply .....	590-0441
Cable, video (CPU to monitor) .....	590-4161
Case parts	
Adjustment panel cover .....	949-0119
Bezel.....	949-0116
Rear cover .....	949-0117
Screw/knob set.....	956-0007
Stand attachment .....	949-0118
CRT assembly .....	076-0246
Power supply .....	661-0395
Printed circuit boards	
Contrast control board .....	905-0004
I/O connector board .....	933-0014
Main board.....	661-0396
Video board "C" case cover .....	948-0031
Video board "C" with cable .....	981-0007
Switches and fuses	
Fuse, 250 V, 2 Amp .....	740-0305
On/off switch.....	937-0025

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## Troubleshooting

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### Symptom/Cure Chart

Use the following chart as a troubleshooting guide. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement. For information on environmental distortions, see the General Monitor Information chapter.

No Raster	Solutions
No raster, LED off	<ol style="list-style-type: none"><li>1. Check that the power cord is properly connected.</li><li>2. Check the internal power connectors.</li><li>3. Check fuse; replace if blown. If it blows again, go to next step.</li><li>4. Replace the power supply.</li><li>5. Replace the power switch assembly.</li></ol>
No raster, LED on	<ol style="list-style-type: none"><li>1. Adjust the brightness and contrast controls.</li><li>2. Verify that the video card (in the CPU) is working properly.</li><li>3. Adjust the sub-brightness (cutoff) control.</li><li>4. Verify that the logic board is connected to the power supply.</li><li>5. Check fuse; replace if blown. If it blows again, go to next step.</li><li>6. Replace the main board.</li><li>7. Replace the power supply.</li><li>8. Replace the power switch assembly.</li><li>9. Replace video board "C."</li><li>10. Replace the contrast control board.</li></ol>
Geometric Problem <sup>1</sup>	Solutions
Raster stretched or compressed on side or top of screen	<ol style="list-style-type: none"><li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li><li>2. Perform appropriate geometric adjustments.</li><li>3. Replace the main board.</li><li>4. Replace the CRT.</li></ol>
Synchronization Problems	Solutions
Picture breaks in diagonal lines	<ol style="list-style-type: none"><li>1. Connect another monitor to the computer and switch power on to verify that a video signal is coming from the computer.</li><li>2. Replace the main board.</li></ol>
Picture rolls vertically	<ol style="list-style-type: none"><li>1. Verify that the video card (in the CPU) is working properly.</li><li>2. Adjust the vertical hold.</li><li>3. Check the connector on the I/O connector board.</li><li>4. Replace the main board.</li></ol>
One horizontal or vertical line appears on screen	<ol style="list-style-type: none"><li>1. Verify that the yoke connectors are tight.</li><li>2. Replace the main board.</li><li>3. Replace the CRT.</li></ol>

---

<sup>1</sup> Remember, slight geometric distortion problems cannot be solved by replacing modules.

---

<b>Video Problems</b>	<b>Solutions</b>
Picture is too dark or too bright	<ol style="list-style-type: none"> <li>1. Adjust the brightness control.</li> <li>2. Verify that the video card (in the CPU) is working properly.</li> <li>3. Adjust the sub-brightness (cutoff) control.</li> <li>4. Replace the main board.</li> <li>5. Replace video board "C."</li> <li>6. Replace the CRT.</li> </ol>
Brightness cannot be adjusted	<ol style="list-style-type: none"> <li>1. Replace the contrast control board.</li> <li>2. Replace the main board.</li> <li>3. Replace the video board "C."</li> <li>4. Replace the CRT assembly.</li> </ol>
Out of focus	<ol style="list-style-type: none"> <li>1. Perform focus adjustments.</li> <li>2. Replace the main board.</li> <li>3. Replace the video board.</li> <li>4. Replace the CRT.</li> </ol>
<b>Misc. Problems</b>	<b>Solutions</b>
Picture jitters	<ol style="list-style-type: none"> <li>1. Verify that all grounding cables are secure.</li> <li>2. Confirm that adjacent computer equipment is properly grounded. Move electrical devices away from the monitor. Temporarily shut off all fluorescent lights in the area.<sup>2</sup></li> <li>3. Replace the main board.</li> </ol>
Flashing lines on screen	<ol style="list-style-type: none"> <li>1. Verify contact of the video connector to the neck of the CRT.</li> <li>2. Replace the contrast control board.</li> <li>3. Replace the main board.</li> </ol>
Black spots on screen (burnt phosphor)	<ul style="list-style-type: none"> <li>– Replace the CRT.</li> </ul>

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<sup>2</sup> External electrical interference problems cannot be solved by monitor adjustments or replacement of modules.

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## Safety Instructions

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**▲ Warning** **The Apple High-Res Monochrome Monitor contains a high-vacuum picture tube and operates at very high voltages. To prevent serious injury, review the CRT safety rules before performing adjustments.**

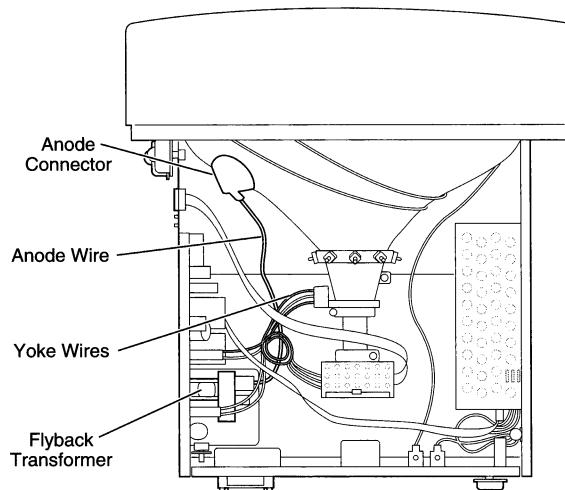
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In addition to following all safety precautions, be sure to:

- Keep one hand behind your back at all times, and grasp the handle of the insulated alignment tool with your other hand.
- Use a mirror for viewing adjustment results.
- Perform only those adjustments that are absolutely necessary. Do not attempt to make any adjustments other than the ones explained in this section, and do those with extreme caution.

**▲ Warning** **Serious injury could result if, with the power on, you touch any of the high-voltage areas shown in Figure 3.**

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**Figure 3 High-Voltage Areas**

## Adjustments

### Geometric Adjustments

#### Materials Required

Plastic screwdriver

Mirror

Flexible metric ruler

Appropriate diagnostic (See the Monitor Diagnostics table in the General Monitor Information chapter.)

#### Horizontal Size

1. FIGURE 4. Set the brightness control to detent (midrange) and the contrast control to maximum (turn clockwise).
2. Boot the diagnostic and display the crosshatch II test pattern.
3. FIGURE 4. Using the plastic screwdriver, turn the Horizontal Size control until the raster is 213.5 mm wide.

#### Vertical Size

1. Display the crosshatch II test pattern.
2. FIGURE 4. Using the plastic screwdriver, turn the Vertical Size control until the raster is 160 mm high.

#### Focus

1. FIGURE 4. Set the brightness control to detent (midrange) and the contrast control to maximum (turn clockwise).
2. Select the focus test pattern.
3. FIGURE 4. Using the plastic screwdriver, adjust the Focus control for best focus at the center of the screen.

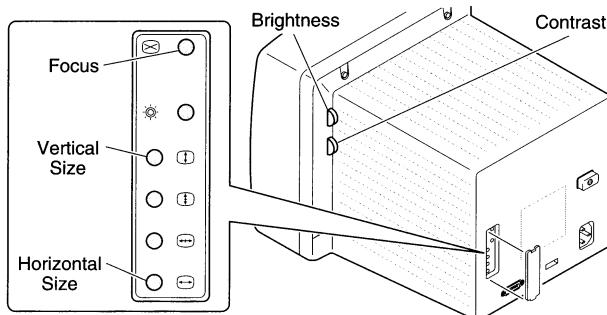


Figure 4 Size and Focus Controls

---

## **Video Adjustments**

Always perform the video adjustments when you replace the main logic board, the contrast control board, or the video board.

### **Materials Required**

Two-inch plastic screwdriver

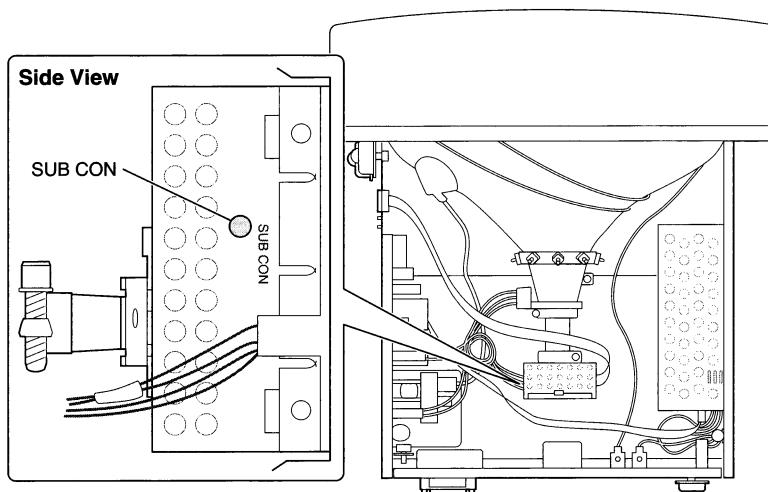
Plastic screwdriver

Light meter (Sekonic Multi-Lumi, model L-248)

Appropriate diagnostic (See the Monitor Diagnostics table in the General Monitor Information chapter.)

### **Cutoff**

1. Remove the monitor's rear cover and set the monitor upright.
2. Connect the monitor's video cable and power cord to the Macintosh computer.
3. FIGURE 5. Using a two-inch plastic screwdriver, turn the SUB CON control to midrange.



**Figure 5 Subcontrast Control**

---

4. FIGURE 6. Set the brightness control to detent (midrange) and the contrast control to maximum (turn clockwise).
5. Boot the diagnostic and display the gray bars pattern.

▲ Caution

If the Cutoff is turned up (clockwise) too far, the monitor may shut down. If this happens, switch off the monitor, turn the Cutoff control all the way down (counterclockwise), and wait 30 seconds. Then switch on the monitor and continue the adjustment.

6. FIGURE 6. Using the plastic screwdriver, turn the Cutoff control (RV506) until the first bar is completely black and the second bar is just visible
7. Set your light meter (Sekonic Multi-Lumi, model L-248) for the 10-to-18 range. Using the light meter, measure the screen luminance at the center of the all-white screen.
8. Display the all-white screen test pattern. Using the light meter, measure the screen luminance at the center of the screen.
9. FIGURE 5. Using the two-inch plastic screwdriver, turn the SUB CON control until the luminance at the center of the screen reads at the middle of the "10" scale on the light meter.

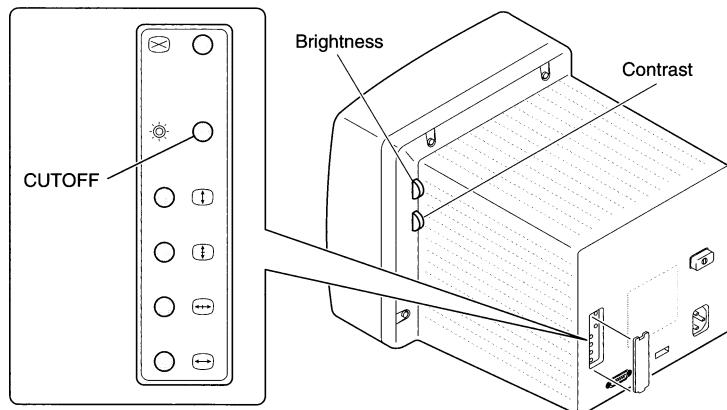


Figure 6 Brightness, Contrast, and Cutoff Controls

# Macintosh 12-Inch Monochrome Display



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## Illustrated Parts List

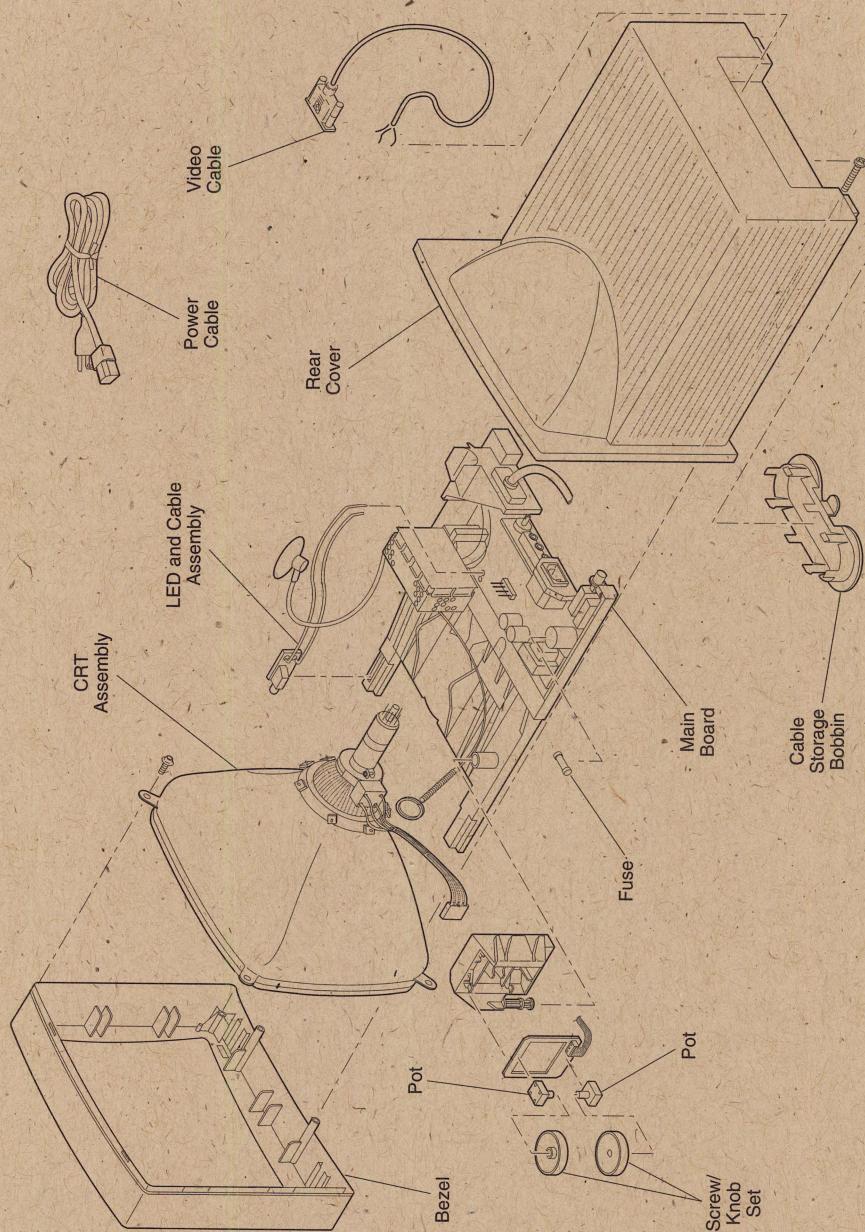


Figure 1 Macintosh 12-Inch Monochrome Display Exploded View

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Cables	
Cable, external power, domestic .....	590-0380
Cable, external power, European.....	590-0420
Cable, LED assembly .....	630-0004
Cable storage bobbin .....	815-1156
Cable, video (CPU to monitor).....	590-4510
Case parts	
Bezel.....	658-8351
Rear cover .....	658-8352
CRT assemblies	
CRT assembly, Australia .....	076-0383
CRT assembly, domestic and Europe (etched)....	076-0382
Fuse, 1 Amp, 250 V .....	941-5220
Main board.....	661-0615
Pots	
Brightness pot, 10 K $\Omega$ , 0.15 W CC .....	109-1022
Contrast pot, 10 K $\Omega$ , 0.15 W.....	109-1020
Screw/knob set .....	956-0023

---

## Troubleshooting

---

### Symptom/Cure Chart

Use the following chart as a troubleshooting guide. If the first corrective action does not solve the problem, reinstall the original module before proceeding to the next step. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement. For information on environmental distortions, see the General Monitor Information chapter.

No Raster	Solutions
No raster, LED off	<ol style="list-style-type: none"><li>1. Check that the power cord is properly connected.</li><li>2. Check the internal power connectors.</li><li>3. Check fuse; replace if blown. If it blows again, go to next step.</li><li>4. Replace the main board.</li></ol>
No raster, LED on	<ol style="list-style-type: none"><li>1. Adjust the brightness and contrast controls.</li><li>2. Adjust the sub-brightness control.</li><li>3. Replace the main board.</li><li>4. Replace the contrast/brightness assembly.</li><li>5. Replace the CRT.</li></ol>
<b>Geometric Problems<sup>1</sup></b>	<b>Solutions</b>
Raster stretched or compressed on side or top of screen	<ol style="list-style-type: none"><li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li><li>2. Replace the main board.</li><li>3. Replace the CRT.</li></ol>
Raster cannot be centered	<ol style="list-style-type: none"><li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li><li>2. Replace the main board.</li></ol>
Synchronization Problems	Solutions
Picture breaks in diagonal lines	<ol style="list-style-type: none"><li>1. Connect another monitor to the computer and switch power on to verify that a video signal is coming from the computer.</li><li>2. Replace the main board.</li></ol>
Picture rolls vertically	<ol style="list-style-type: none"><li>1. Verify that the video card (in the CPU) is working properly.</li><li>2. Replace the main board.</li></ol>
One horizontal or vertical line appears on screen	<ol style="list-style-type: none"><li>1. Verify that the yoke connectors are tight.</li><li>2. Replace the main board.</li><li>3. Replace the CRT.</li></ol>

---

<sup>1</sup> Remember, slight geometric distortion problems cannot be solved by replacing modules.

---

<b>Video Problems</b>	<b>Solutions</b>
Flashing lines on screen	<ol style="list-style-type: none"> <li>1. Verify contact of the video connector to the neck of the CRT.</li> <li>2. Replace the contrast/brightness assembly.</li> <li>3. Replace the main board.</li> </ol>
Picture is too dark or too bright	<ol style="list-style-type: none"> <li>1. Adjust the brightness control.</li> <li>2. Verify that the video card (in the CPU) is working properly.</li> <li>3. Adjust the sub-brightness control.</li> <li>4. Replace the main board.</li> <li>5. Replace the CRT.</li> </ol>
Brightness cannot be adjusted	<ol style="list-style-type: none"> <li>1. Replace the contrast/brightness assembly.</li> <li>2. Replace the main board.</li> <li>3. Replace the CRT.</li> </ol>
Out of focus	<ol style="list-style-type: none"> <li>1. Perform focus adjustments.</li> <li>2. Replace the main board.</li> <li>3. Replace the CRT.</li> </ol>
<b>Misc. Problems</b>	<b>Solutions</b>
Picture jitters	<ol style="list-style-type: none"> <li>1. Verify that all grounding cables are secure.</li> <li>2. Verify that adjacent computer equipment is properly grounded. Move electrical devices away from the monitor. Temporarily shut off all fluorescent lights in the area.<sup>2</sup></li> <li>3. Replace the main board.</li> </ol>
Black spots on screen (burnt phosphor)	<ul style="list-style-type: none"> <li>– Replace the CRT.</li> </ul>

---

<sup>2</sup> External electrical interference problems cannot be solved by monitor adjustments or replacement of modules.

---

## Safety Instructions

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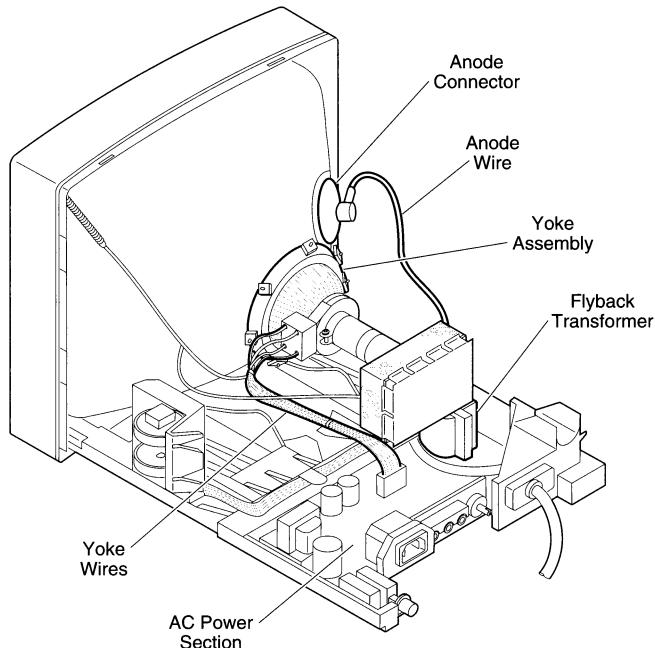
**▲ Warning** **The Macintosh 12-Inch Monochrome Display contains a high-vacuum picture tube and operates at very high voltages. To prevent serious injury, review the CRT Safety rules in the General Monitor Information chapter.**

---

- Keep one hand behind your back at all times, and grasp the handle of the insulated alignment tool with your other hand.
- Use a mirror for viewing adjustment results.
- Perform only those adjustments that are absolutely necessary. Do not attempt to make any adjustments other than the ones explained in this section, and do those with extreme caution.

**▲ Warning** **Serious injury could result if, with the power on, you touch any of the high-voltage areas shown in Figure 2.**

---



**Figure 2 High-Voltage Areas**

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## Adjustments

---

### Geometric Adjustments

#### Materials Required

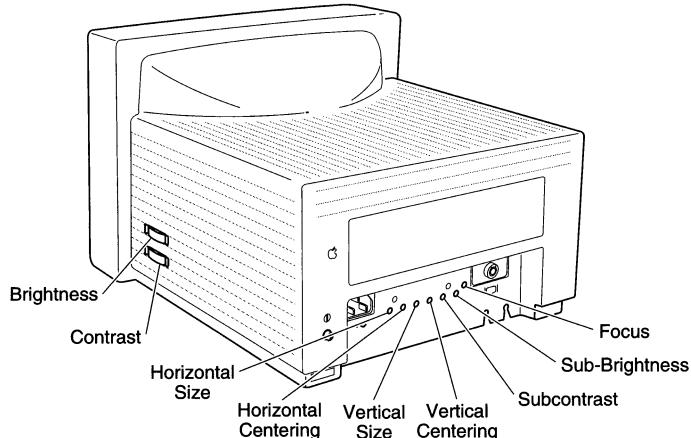
Plastic adjustment tool (insulated screwdriver)  
Mirror  
Flexible metric ruler  
Appropriate diagnostic (See the Monitor Diagnostics table in the General Monitor Information chapter.)

#### Horizontal

1. Boot the diagnostic and select the all-white screen or crosshatch II test pattern.
2. FIGURE 3. Using the insulated screwdriver, turn the Horizontal Size control until the raster is  $213.5 \text{ mm} \pm 2.5 \text{ mm}$  wide.
3. FIGURE 3. Using the insulated screwdriver, turn the Horizontal Centering control until the raster is centered (left to right) in the bezel.

#### Vertical

1. Boot the diagnostic and select the all-white screen or crosshatch II test pattern.
2. FIGURE 3. Using the insulated screwdriver, turn the Vertical Size control until the raster is  $159.5 \text{ mm} \pm 2.5 \text{ mm}$  high.
3. FIGURE 3. Using the insulated screwdriver, turn the Vertical Centering control until the raster is centered (top to bottom) in the bezel.



**Figure 3 Adjustment Control Locations**

---

## **Focus**

1. FIGURE 3. Turn the brightness control to the detent position (midrange) and turn the contrast control to maximum (full clockwise).
2. Boot the diagnostic and select the focus test pattern.
3. FIGURE 3. Adjust the Focus control for the best focus at the center of the screen.

---

## **Video Adjustments**

### **Materials Required**

Plastic adjustment tool (insulated screwdriver)

Mirror

Light meter

Appropriate diagnostic (See the Monitor Diagnostics table in the General Monitor Information chapter.)

### **Sub-Brightness**

1. FIGURE 3. Turn the brightness control to the detent position (midrange) and the contrast control to maximum (full clockwise).
2. Boot the diagnostic and select the gray bars test pattern.
3. FIGURE 3. Using the insulated screwdriver, adjust the Sub-Brightness control until the first bar of the test pattern is completely black and the second bar is just visible.

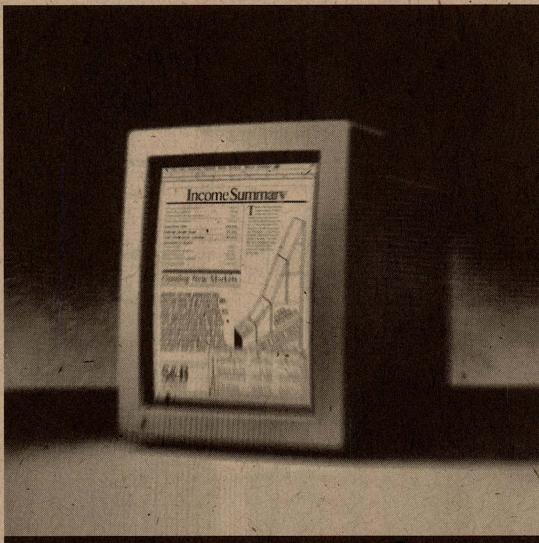
#### **Note**

If the Sub-Brightness control is set too high, the scroll bars on the monitor screen may display a dashed or irregular pattern. If this happens, turn the Sub-Brightness control down about a quarter-turn and readjust the Sub-Brightness.

### **Subcontrast**

1. FIGURE 3. Turn the brightness control to the detent position (midrange) and the contrast control to maximum (full clockwise).
2. Boot the diagnostic and select the all-white screen test pattern.
3. Set your light meter (Sekonic Multi-Lumi, model L-248) for the 10-to-18 range.
4. FIGURE 3. Using the insulated screwdriver, adjust the Subcontrast control until the luminance at the center of the screen reads in the middle of the "10" scale on the light meter.

# **Apple Macintosh Portrait Display**



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## Illustrated Parts List

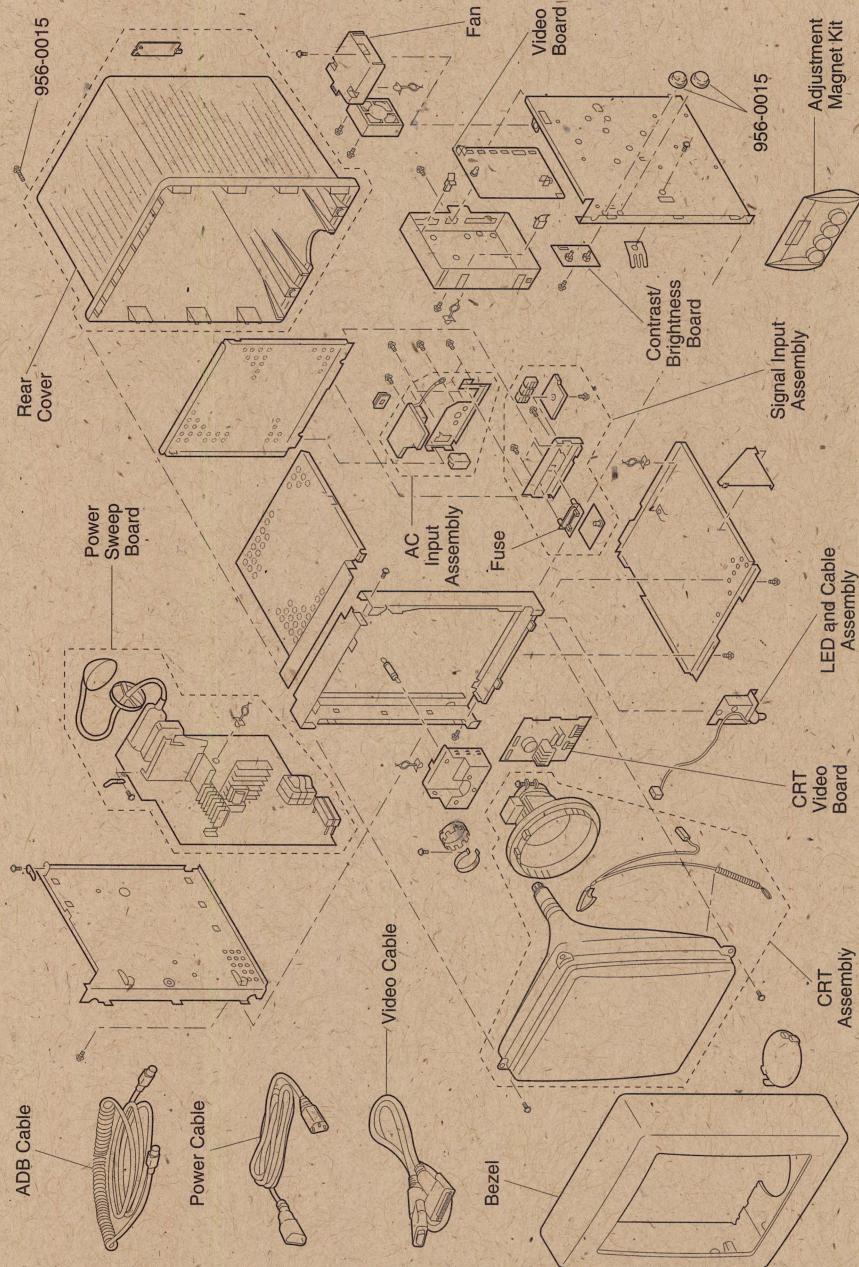


Figure 1 Apple Macintosh Portrait Display Exploded View

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Adjustment magnet kit .....	949-0253
Cables	
Cable, ADB .....	590-4501
Cable, external power, domestic .....	590-0371
Cable, external power, European.....	590-0421
Cable, LED assembly .....	590-0071
Cable, video, DB-25 to DB-25 (CPU to monitor).....	590-0574
Cable, video, DB-25 to DA-15 (CPU to monitor).....	590-0615
Case parts	
Bezel.....	949-0079
Rear cover .....	949-0089
Screw/knob set .....	956-0015
CRT assembly .....	076-0350
Fuse, 250 V, 4 Amp, (5/pk) .....	941-0017
Other assemblies	
AC input assembly with fuse .....	937-0019
Fan assembly .....	983-0014
Signal input assembly.....	937-0022
Printed circuit boards	
CRT video board.....	661-0119
Contrast/brightness board.....	982-0004
Power sweep board .....	661-0117
Video board .....	661-0118

---

## Troubleshooting

---

### Symptom/Cure Chart

Use the following chart as a troubleshooting guide. When troubleshooting, remember environmental distortions are common and cannot be corrected by monitor adjustments or module replacement. For information on environmental distortions, see the General Monitor Information chapter.

No Raster	Solutions
No raster, LED off	<ol style="list-style-type: none"><li>1. Check that the power cord is properly connected.</li><li>2. Check the internal power connectors.</li><li>3. Check fuse; replace if blown. If it blows again, go to next step.</li><li>4. Replace the power sweep board.</li><li>5. Replace the video board.</li></ol>
No raster, LED on	<ol style="list-style-type: none"><li>1. Adjust the brightness and contrast controls.</li><li>2. Verify that the video card (in the CPU) is working properly.</li><li>3. Perform the video adjustments.</li><li>4. Check the internal power connectors.</li><li>5. Replace the power sweep board.</li><li>6. Replace the CRT board.</li><li>7. Replace the video board.</li><li>8. Replace the CRT.</li></ol>
Geometric Problems <sup>1</sup>	Solutions
Raster short (not 10 7/8 inches high)	<ol style="list-style-type: none"><li>1. Adjust the height adjustment.</li><li>2. Replace the power sweep board.</li><li>3. Replace the CRT.</li></ol>
Raster narrow (not 8 inches wide)	<ol style="list-style-type: none"><li>1. Adjust the H.SIZE control.</li><li>2. Replace the power sweep board.</li><li>3. Replace the CRT.</li></ol>
Raster cannot be centered	<ol style="list-style-type: none"><li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li><li>2. Adjust the H.CENT or V.CENT controls.</li><li>3. Replace the power sweep board.</li><li>4. Replace the CRT.</li></ol>
Raster bulges along top of screen	<ol style="list-style-type: none"><li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li><li>2. Replace the CRT.</li></ol>
Raster stretched or compressed on top of screen	<ol style="list-style-type: none"><li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li><li>2. Adjust the V.LIN control.</li><li>3. Replace the power sweep board.</li><li>4. Replace the CRT.</li></ol>

---

<sup>1</sup> Remember, slight geometric distortion problems cannot be solved by replacing modules.

---

Raster bowed or barrel shaped

1. Verify that distortion is not due to environmental conditions (move monitor to a different location).
2. Perform the video adjustments.
3. Replace the power sweep board.
4. Replace the CRT.

Raster pyramid shaped (or inverted pyramid)

- Replace the CRT.

### Synchronization Problems

Picture breaks in diagonal lines

#### Solutions

1. Connect another monitor to the computer and switch power on to verify that a video signal is coming from the computer.
2. Replace the power sweep board.

Picture rolls vertically

1. Verify that the video card (in the CPU) is working properly.
2. Replace the power sweep board.

One thin bright horizontal line appears on screen

1. Replace the power sweep board.
2. Replace CRT.

### Video Problems

Picture is too dark or too bright

#### Solutions

1. Adjust the contrast and brightness controls.
2. Verify that the video card (in the CPU) is working properly.
3. Perform the video adjustments.
4. Replace the CRT board.
5. Replace the video board.
6. Replace the contrast/brightness board.
7. Replace the CRT.

Out of focus

1. Perform the focus adjustment.
2. Replace the power sweep board.
3. Replace the CRT.

### Misc. Problems

Intermittent shutdown

#### Solutions

- Replace the power sweep board.

Picture jitters or flashes

1. Verify that all ground cables are secure.
2. Verify that adjacent computer equipment is properly grounded. Move electrical devices away from the monitor. Temporarily shut off all fluorescent lights in the area.<sup>2</sup>
3. Replace the power sweep board.

Black spots on screen (burnt phosphor)

- Replace CRT.

---

<sup>2</sup> External electrical interference problems cannot be solved by monitor adjustments or replacement of modules.

---

## Safety Instructions

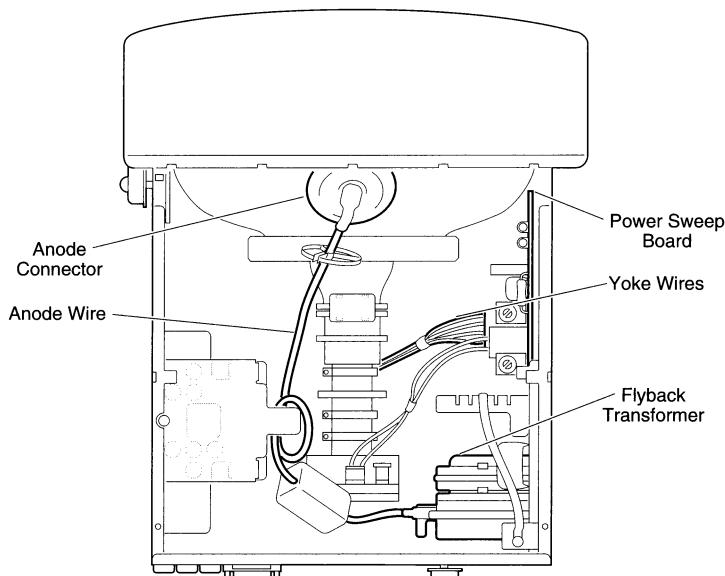
**▲ Warning** The Apple Macintosh Portrait Display contains a high-vacuum picture tube and operates at very high voltages. To prevent serious injury, review the CRT Safety rules in the General Monitor Information chapter.

---

- Keep one hand behind your back at all times, and grasp the handle of the insulated alignment tool with your other hand.
- Use a mirror for viewing adjustment results.
- Perform only those adjustments that are absolutely necessary. Do not attempt to make any adjustments other than the ones explained in this section, and do those with extreme caution.

**▲ Warning** Serious injury could result if, with the power on, you touch any of the high-voltage areas shown in Figure 2.

---



**Figure 2 High-Voltage Areas**

---

## Adjustments

---

### Geometric Adjustments

#### Materials Required

Plastic adjustment tool (insulated screwdriver)

Plastic hex alignment tool

Appropriate diagnostic (See the Monitor Diagnostics table in the General Monitor Information chapter.)

#### Horizontal

1. Boot the diagnostic disk and select the all-white screen test pattern.
2. FIGURE 3. Using the hex alignment tool, turn the H.SIZE control until the raster is 203 mm wide.
3. FIGURE 3. Using the insulated screwdriver, turn the H.CENT control until the raster is centered (left to right) in the display area.
4. Verify that the raster is still 203 mm wide. If it is not, readjust the H.SIZE and H.CENT controls.
5. FIGURE 3. Measure the black margin on the right side of the test pattern. The black margin should measure 7 to 8 mm from the right edge of the white raster to the edge of the bezel. If it is not, use the insulated screwdriver to turn the H.PHASE control until the black margin is 7 to 8 mm wide.
6. If the raster is bowed, adjust the SIDE.PIN control until the raster is straight.

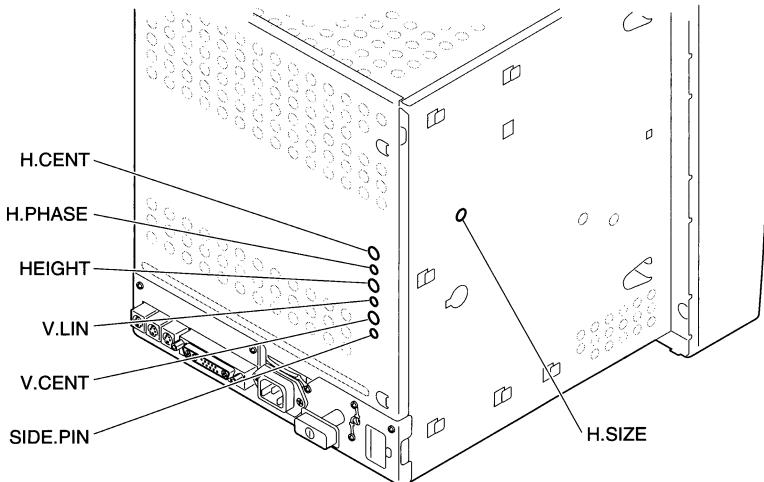


Figure 3 Horizontal and Vertical Adjustment Controls

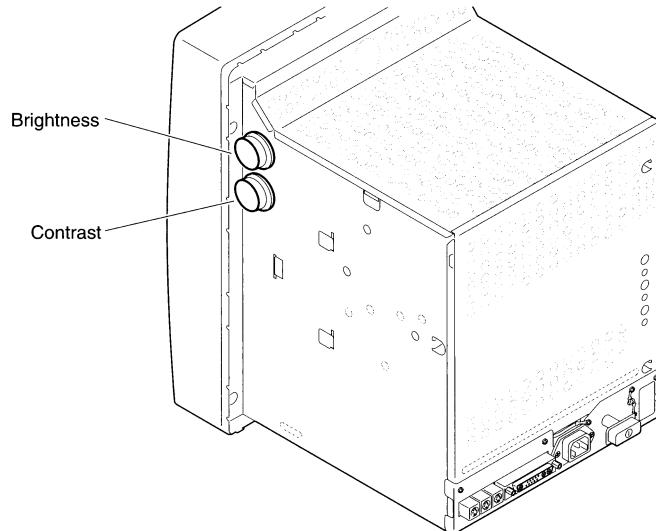
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## **Vertical**

1. Boot the diagnostic disk and select the all-white screen test pattern.
2. FIGURE 3. Turn the HEIGHT control until the raster is 276 mm high.
3. FIGURE 3. Turn the V.CENT control until the raster is centered (top to bottom) in the display area.
4. Verify that the raster is still 276 mm high. If it is not, readjust the HEIGHT and V.CENT controls.
5. Display the crosshatch II test pattern.
6. FIGURE 3. Turn the V.LIN control until the boxes at the top of the display are the same size as the boxes at the bottom.

## **Focus**

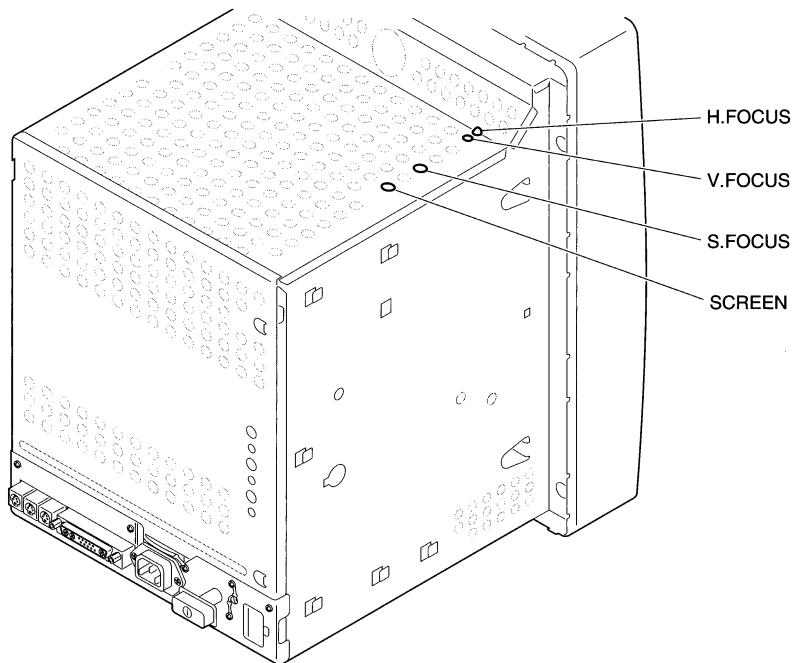
1. Boot the diagnostic disk and select the focus test pattern.
2. FIGURE 4. Turn the brightness control to the detent position (midrange) and contrast control to maximum (full clockwise).



**Figure 4 Brightness and Contrast Controls**

---

3. FIGURE 5. Turn the SCREEN control to its full counterclockwise position.
4. FIGURE 5. Adjust the S.FOCUS control for the best overall focus.
5. FIGURE 5. Adjust the H.FOCUS control for the best focus on the left and right sides of the screen.
6. FIGURE 5. Adjust the V.FOCUS control for the best possible focus at the top and bottom of the screen.
7. If necessary, repeat steps 4 to 6 for best overall focus.



**Figure 5 Focus Adjustment Control**

---

## Video Adjustments

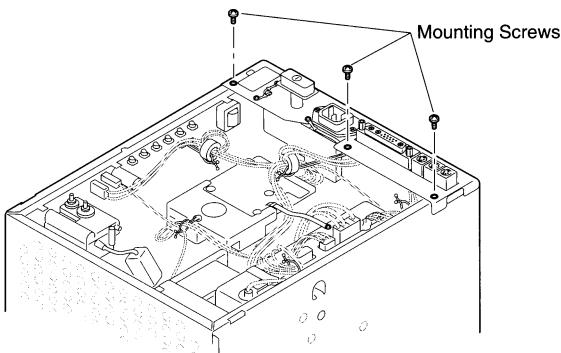
### Materials Required

Plastic alignment tool (insulated screwdriver)

Light meter (Sekonic Multi-Lumi, model L-248)

Appropriate diagnostic (See the Monitor Diagnostics table in the General Monitor Information chapter.)

**▲ Caution** **FIGURE 6. With the rear panel of the EMI shield removed, the signal input board assembly is loose and could short to chassis ground. To prevent damaging the monitor, reinstall the three mounting screws in the metal brackets and chassis.**



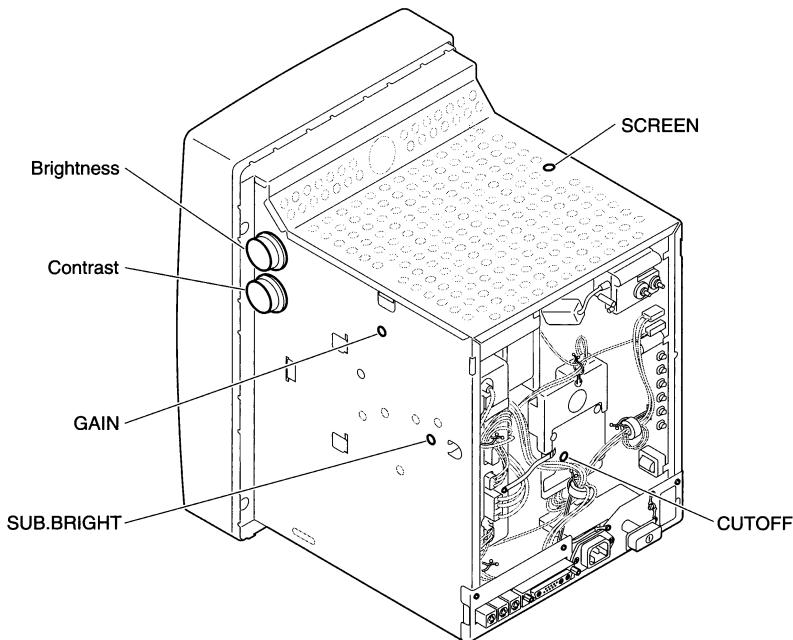
**Figure 6 Replacing Mounting Screws**

1. Boot the diagnostic and select the gray bars test pattern.
2. FIGURE 7. Turn the SCREEN control to maximum (full counterclockwise).
3. FIGURE 7. Turn the GAIN control to its center position.
4. FIGURE 7. Turn the SUB.BRIGHT control to maximum brightness (full clockwise).
5. Select the all-black screen test pattern. (Because adjustment controls have been turned up, the screen may appear dark gray rather than black).
6. FIGURE 7. Turn the brightness and contrast controls to maximum (full clockwise).
7. FIGURE 7. Turn the CUTOFF control clockwise until retrace lines are just visible on the display. Then turn the CUTOFF control counterclockwise until the retrace lines just disappear.

---

**▲ Caution** If the cutoff is set too high, the monitor may shut down. If this happens, switch off the monitor, turn the CUTOFF control all the way down (counterclockwise), and wait 30 seconds. Then switch on the monitor and continue the adjustment.

8. Select the gray bars test pattern and set the brightness control to midrange—the detent position.
9. FIGURE 7. Adjust the SUB.BRIGHT control so that bar 1 is completely black.
10. Select the all-white screen test pattern and measure screen luminance. Adjust the GAIN control until the screen luminance measures at "11" on the light meter.
11. FIGURE 7. Set the brightness control to maximum (full clockwise) and recheck the screen luminance. If the screen luminance measures out of the "11" scale on the light meter, repeat steps 8 through 11.

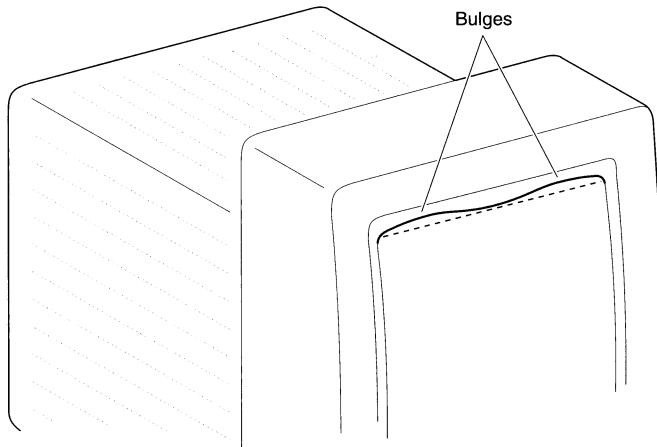


**Figure 7 Video Adjustments**

---

## Magnet Adjustment

Some Apple Portrait Displays may exhibit distortions along the upper edge of the screen as shown in Figure 8. Use the following procedure to correct distortions in the upper-left and upper-right corners of the screen. Use the weakest magnet possible to correct the distortion problem, and always adjust any distortion in the upper-left corner of the screen first. Do not adjust distortion in the upper-right corner of the screen unless the distortion is so severe that the display is unacceptable to the customer.



**Figure 8 Magnetic Distortions**

### **Materials Required**

Adjustment magnet kit  
Silicone rubber glue (also used as bathroom tub sealant)  
Black electrical tape  
Plastic packaging paper

1. Remove the rear cover and the EMI shield.

**▲ Caution**

**FIGURE 6. With the rear panel of the EMI shield removed, the signal input board assembly is loose and could short to chassis ground. To prevent damaging the monitor, reinstall the three mounting screws in the metal brackets and chassis.**

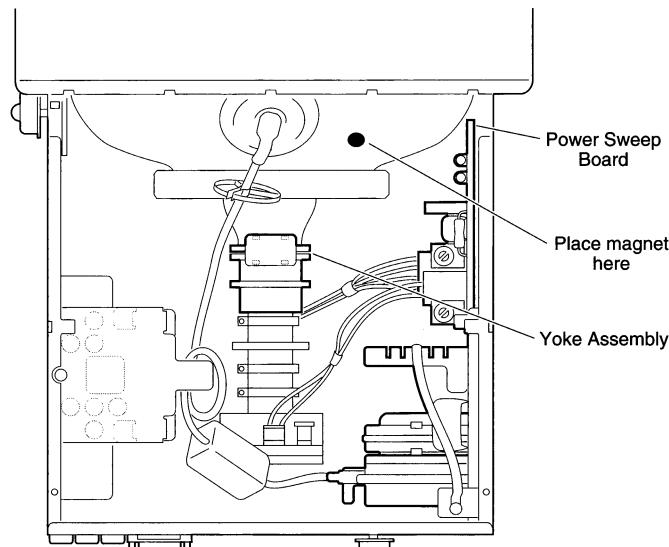
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2. Place the monitor upright on a grounded workbench pad. (Do not put on a grounding wriststrap.)

**▲ Warning**

**FIGURE 9. The power sweep board contains high-voltage components. To prevent touching high-voltage areas on the power sweep board, cover the board with plastic packaging paper before performing the adjustment procedure. Make sure transistor Q711 is covered. The yoke assembly also carries high-voltage.**

3. FIGURE 9. Cover the power sweep board with plastic packaging paper.
4. Connect the video cable and power cable to the monitor and switch on monitor power.
5. FIGURE 9. Observe the monitor screen. If the upper-left corner of the screen is distorted, place the weakest (green) magnet on the back of the CRT to the right of the anode cap. While looking at the screen display, rotate and move the magnet from side-to-side and up-and-down until you get the least distortion.



**Figure 9 Placing the Magnet**

---

If the weakest magnet is unable to correct the distortion, try the next strongest (white) magnet. From weakest to strongest, the magnets are color-coded as follows:

- Green (weakest)
- White
- Not colored
- Red (strongest)

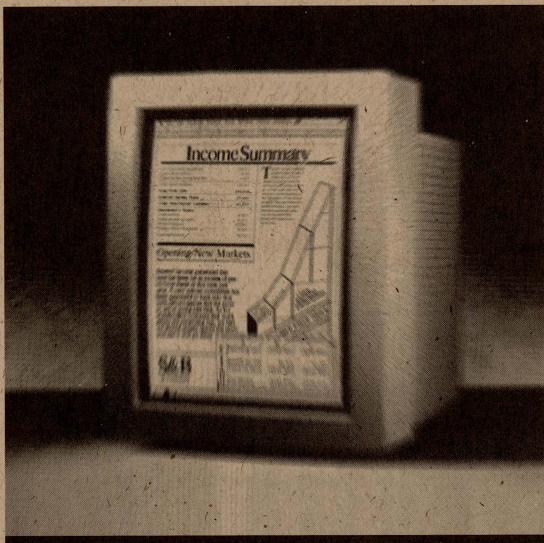
**▲ Warning**

**If you should drop a magnet into the monitor, be sure to switch off monitor power and remove all cables before retrieving the magnet.**

---

6. When you have found the magnet that best eliminates the distortion problem, note its approximate position on the back of the CRT.
7. Apply silicone sealant to the back of the magnet, and replace it on the back of the CRT. Rotate and move the magnet as necessary to get the best possible picture, and then tape the magnet into position with black electrical tape.
8. If the upper-right corner of the screen is distorted, place the weakest (green) magnet on the back of the CRT to the left of the anode cap and repeat steps 5 through 7.
9. Switch off the monitor and allow the silicone glue to dry.
10. Replace the EMI shield and rear cover.

# **Apple Macintosh Portrait Display "Series B"**



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## Illustrated Parts List

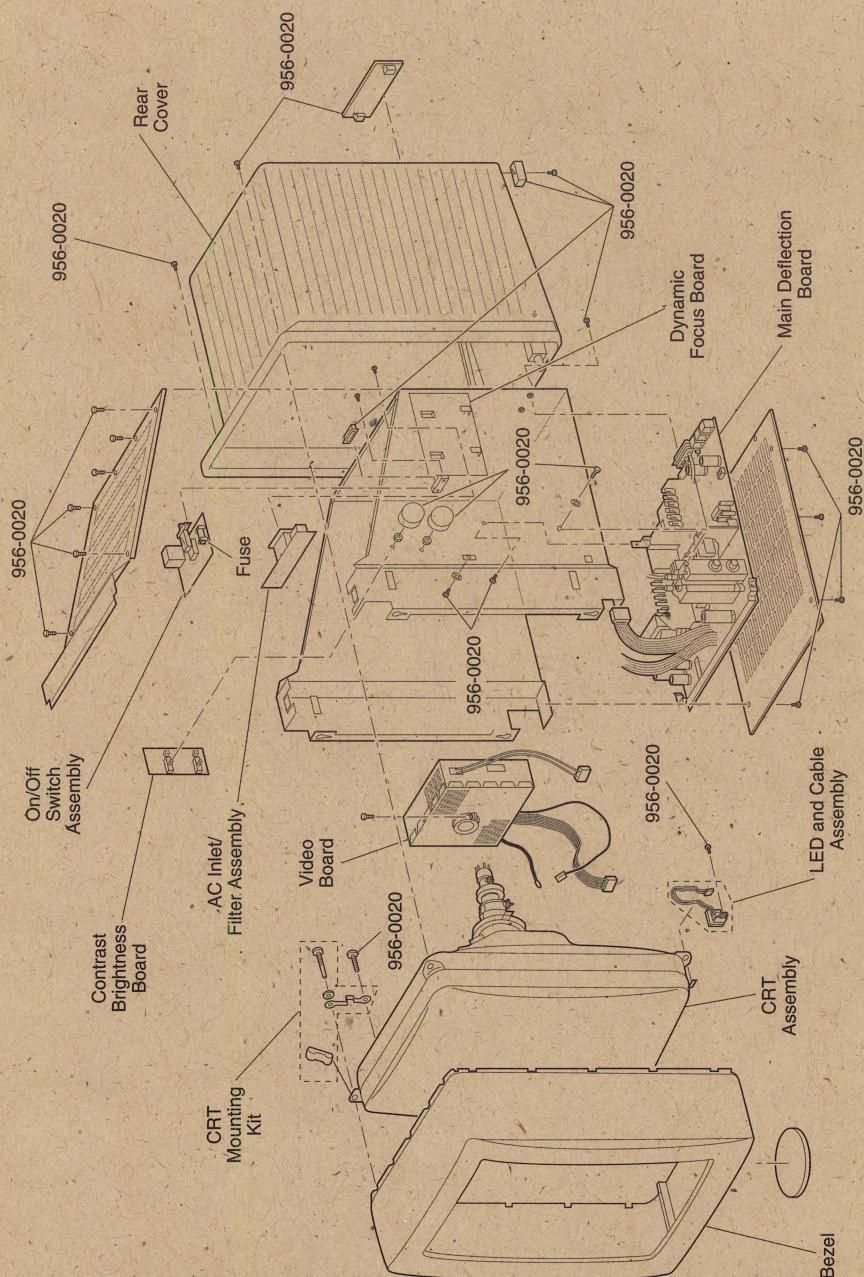


Figure 1 Apple Macintosh Portrait Display "Series B" Exploded View

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Cables	
Cable, external power (not shown) .....	590-0421
Cable, ADB (not shown).....	590-4501
Cable, LED assembly .....	590-0610
Cable, video, DB-25 to DA-15 (CPU to monitor, not shown).....	590-0615
Cable, video, DB-25 to DB-25 (CPU to monitor, not shown).....	590-0574
Case parts	
Bezel.....	949-0244
CRT mounting kit .....	076-0322
Rear cover .....	949-0245
Screw/knob set.....	956-0020
CRT assemblies	
CRT assembly, VDE-B version .....	076-0331
CRT assembly, VDE-B version, antistatic .....	076-0391
Fuse, 1.25 A, 250 V (5/pk).....	941-0018
Other assemblies	
AC inlet/filter assembly, 110/240 V .....	915-0043
On/off switch assembly .....	937-0043
Printed circuit boards	
Contrast/brightness board.....	982-0028
Dynamic focus board, VDE-B version .....	661-1603
Main deflection board, VDE-B version.....	661-0580
Video board .....	661-0539

---

## Troubleshooting

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### Symptom/Cure Chart

Use the following chart as a troubleshooting guide. If the first corrective action does not solve the problem, reinstall the original module before proceeding to the next step. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement. For information on environmental distortions, see the General Monitor Information chapter.

No Raster	Solutions
No raster, LED off	<ol style="list-style-type: none"><li>1. Check that the power cord is properly connected.</li><li>2. Check the internal power connectors.</li><li>3. Check fuse; replace if blown. If it blows again, go to next step.</li><li>4. Replace the main deflection board.</li></ol>
No raster, LED on	<ol style="list-style-type: none"><li>1. Adjust the brightness and contrast controls.</li><li>2. Verify that the video card (in the CPU) is working properly.</li><li>3. Check the internal power connectors.</li><li>4. Perform video adjustments.</li><li>5. Replace the main deflection board.</li><li>6. Replace the video board.</li></ol>
Geometric Problems <sup>1</sup>	Solutions
Raster short (not 276 mm high)	<ol style="list-style-type: none"><li>1. Adjust the V.AMP control.</li><li>2. Replace the main deflection board.</li><li>3. Replace the CRT.</li></ol>
Raster narrow (not 203 mm wide)	<ol style="list-style-type: none"><li>1. Adjust the H.AMP control.</li><li>2. Replace the main deflection board.</li><li>3. Replace the CRT.</li></ol>
Raster cannot be centered	<ol style="list-style-type: none"><li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li><li>2. Perform the geometric adjustments.</li><li>3. Replace the main deflection board.</li></ol>
Raster bulges along top of screen	<ol style="list-style-type: none"><li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li><li>2. Replace the CRT.</li></ol>
Raster stretched or compressed on side or top of screen	<ol style="list-style-type: none"><li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li><li>2. Adjust the V.LIN control.</li><li>3. Replace the main deflection board.</li><li>4. Replace the CRT.</li></ol>

---

<sup>1</sup> Remember, slight geometric distortion problems cannot be solved by replacing modules.

---

Raster bowed or barrel shaped	<ol style="list-style-type: none"> <li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li> <li>2. Perform the video adjustment.</li> <li>3. Replace the main deflection board.</li> <li>4. Replace the CRT.</li> </ol>
Raster pyramid shaped (or inverted pyramid)	<ul style="list-style-type: none"> <li>– Replace the CRT.</li> </ul>
<b>Synchronization Problems</b>	<b>Solutions</b>
Picture breaks in diagonal lines	<ol style="list-style-type: none"> <li>1. Connect another monitor to the computer and switch power on to verify that a video signal is coming from the computer.</li> <li>2. Replace the main deflection board.</li> </ol>
Picture rolls vertically	<ol style="list-style-type: none"> <li>1. Verify that the video card (in the CPU) is working properly.</li> <li>2. Replace the main deflection board.</li> </ol>
One thin bright horizontal line appears on screen	<ol style="list-style-type: none"> <li>1. Replace the main deflection board.</li> <li>2. Replace the CRT.</li> </ol>
<b>Video Problems</b>	<b>Solutions</b>
Picture is too bright; or retrace lines are present	<ol style="list-style-type: none"> <li>1. Adjust the contrast and brightness controls.</li> <li>2. Verify that the video card (in the CPU) is working properly.</li> <li>3. Perform the video adjustment.</li> <li>4. Replace the video board.</li> <li>5. Replace the contrast/brightness board.</li> </ol>
Out of focus	<ol style="list-style-type: none"> <li>1. Perform the focus adjustment.</li> <li>2. Replace the main deflection board.</li> <li>3. Replace the dynamic focus board.</li> <li>4. Replace the CRT.</li> </ol>
Characters on left larger or smaller than characters on right	<ol style="list-style-type: none"> <li>1. Adjust the H.LIN control.</li> <li>2. Replace the main deflection board.</li> </ol>
<b>Misc. Problems</b>	<b>Solutions</b>
Intermittent shutdown	<ul style="list-style-type: none"> <li>– Replace the power sweep board.</li> </ul>
Picture jitters or flashes	<ol style="list-style-type: none"> <li>1. Verify that all ground cables are secure.</li> <li>2. Verify that adjacent computer equipment is properly grounded. Move electrical devices away from the monitor. Temporarily shut off all fluorescent lights in the area.<sup>2</sup></li> <li>3. Replace the main deflection board.</li> </ol>

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<sup>2</sup> External electrical interference problems cannot be solved by monitor adjustments or module replacement.

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## Safety Instructions

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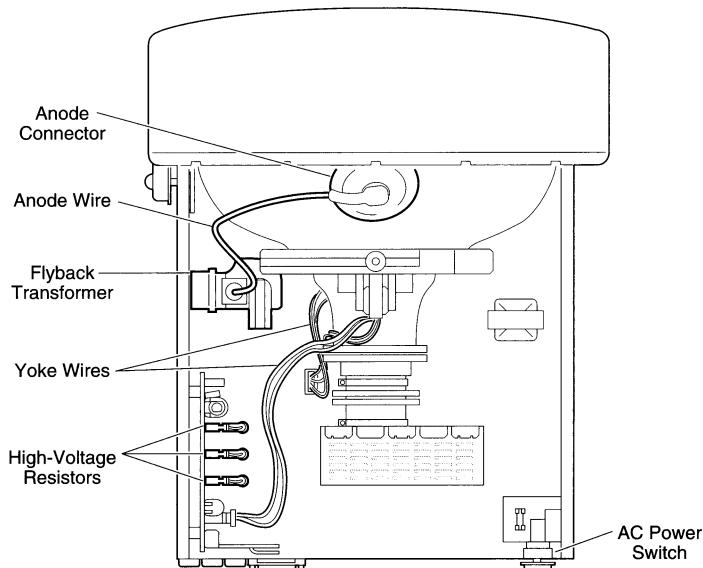
**▲ Warning** The Macintosh Portrait Display "Series B" contains a high-vacuum picture tube and operates at very high voltages. To prevent serious injury, review the CRT Safety rules in the General Monitor Information chapter.

---

- Keep one hand behind your back at all times, and grasp the handle of the insulated alignment tool with your other hand.
- Use a mirror for viewing adjustment results.
- Perform only those adjustments that are absolutely necessary. Do not attempt to make any adjustments other than the ones explained in this section, and do those with extreme caution.

**▲ Warning** Serious injury could result if, with the power on, you touch any of the high-voltage areas shown in Figure 2.

---



**Figure 2 High-Voltage Areas**

---

## Adjustments

---

### Geometric Adjustments

#### Materials Required

Plastic adjustment tool (insulated plastic screwdriver)

Plastic hex alignment tool

Mirror

Appropriate diagnostic (See the Monitor Diagnostics table in the General Monitor Information chapter.)

---

**▲ Warning** Always use an insulated screwdriver when performing live video adjustments. For the following procedures, also make sure the insulated screwdriver has a plastic tip.

---

#### Vertical

1. Display the all-white screen test pattern.
2. FIGURE 3. Turn the V.AMP control until the raster is 276 mm high.
3. FIGURE 3. Turn the V.SHIFT control until the raster is centered (top to bottom) in the display area.
4. Verify that the raster is 276 mm high. If necessary, readjust the V.AMP and V.SHIFT controls.
5. Switch off the monitor and remove the video and power cables.
6. Remove the rear cover.
7. Reconnect the power and video cables to the monitor and switch on the monitor.
8. Display the crosshatch II test pattern.
9. Place the monitor on its side, with the bottom facing you. Use the mirror to view the screen display.

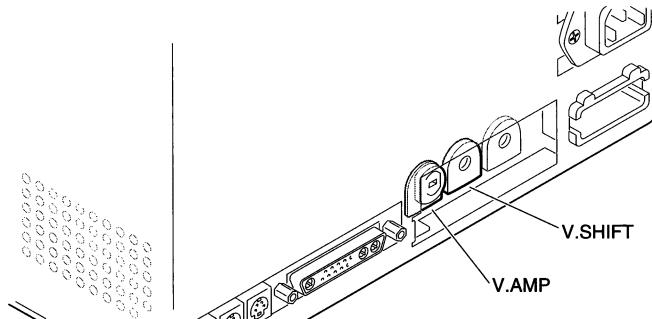


Figure 3 V.AMP and V.SHIFT Controls

---

10. FIGURE 4. Turn the V.LIN control until the boxes at the top of the display are the same size as those at the bottom.
11. Verify that the raster is 276 mm high. If necessary, readjust the V.AMP and V.SHIFT controls.

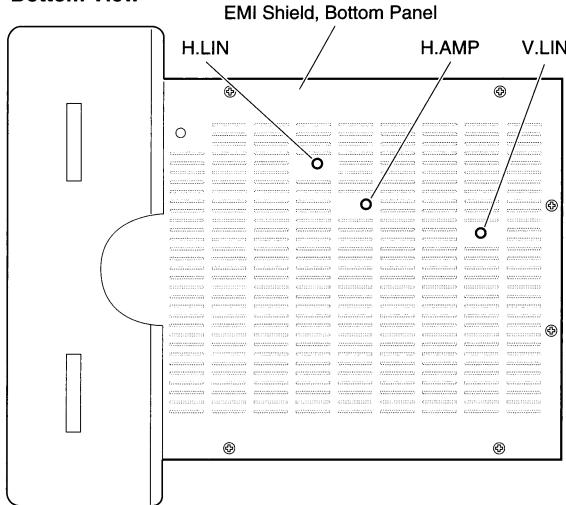
### Horizontal

1. Switch off the monitor and remove the video and power cables.
2. Remove the rear cover.
3. Reconnect the power and video cables to the monitor and switch on the monitor.
4. FIGURE 4. Turn the H.AMP control until the raster is 203 mm wide.

#### Note

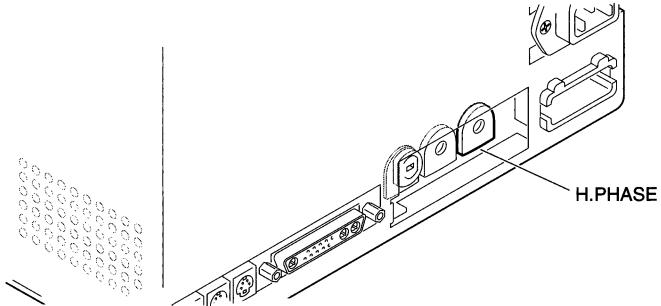
On some monitors you may need to remove the bottom panel of the EMI shield to adjust the H.AMP control.

**Bottom View**



**Figure 4 H.AMP, H.LIN, and V.LIN Controls**

5. FIGURE 5. Turn the H.PHASE control until the raster is centered (left to right) in the display area.
6. Verify that the raster is 203 mm wide. If necessary, readjust the H.AMP and H.PHASE controls.
7. Display the crosshatch II test pattern.



**Figure 5 H.PHASE Control**

8. Place the monitor on its side, with the bottom facing you. Use the mirror to view the screen display.
9. FIGURE 4. Using the hex alignment tool, turn the H.LIN control until the boxes at the left of the display are the same size as those at the right.
10. Verify that the raster is 203 mm wide. If necessary, readjust the H.AMP and H.PHASE controls.

### **Focus**

1. Switch off the monitor and remove the video and power cables.
2. Remove the rear cover.
3. Reconnect the power and video cables to the monitor and switch on the monitor.
4. Display the focus test pattern.
5. FIGURE 6. Turn the brightness control to detent (midrange) and turn the contrast control to maximum (full clockwise).

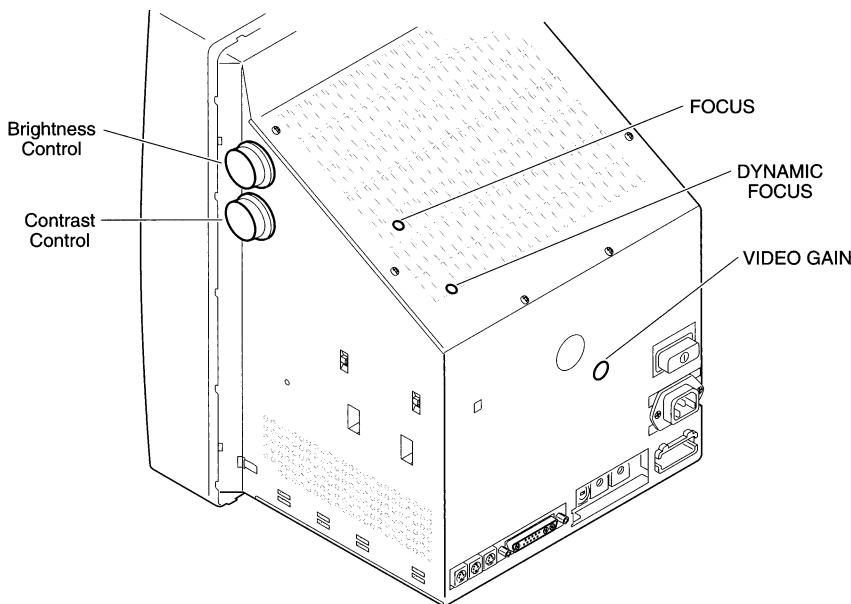
#### **▲ Warning**

**To prevent serious injury, do not touch the three high-voltage resistors on the dynamic focus board. These resistors are labeled R517, R518, and R520.**

6. FIGURE 6. Adjust the FOCUS control for best overall focus.

#### **Note**

On some monitors you may need to remove the top panel of the EMI shield to adjust the focus control.



**Figure 6 FOCUS and VIDEO GAIN Controls**

7. FIGURE 6. Turn the DYNAMIC FOCUS control for the best focus on the left and right sides of the screen.
8. Repeat steps 6 and 7 for best overall focus.

## **Video Adjustments**

### **Materials Required**

Plastic alignment tool (insulated screwdriver)

Mirror

Light meter (Sekonic Multi-Lumi, model L-248)

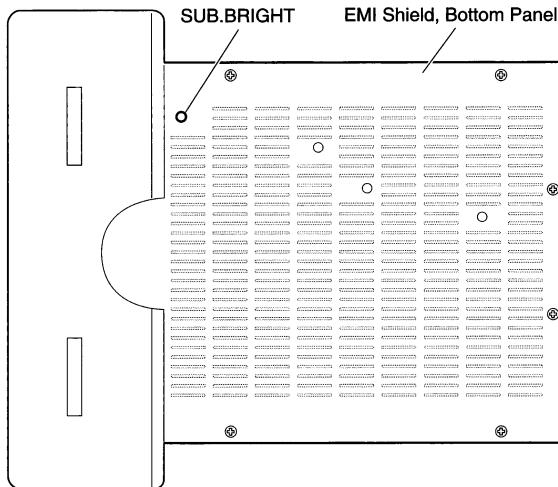
Appropriate diagnostic (See the Monitor Diagnostics table in the General Monitor Information chapter.)

1. Switch off the monitor and remove the video and power cables.
2. Remove the rear cover.
3. Reconnect the power and video cables to the monitor and switch on the monitor.
4. Display the gray bars test pattern.
5. Turn the brightness control to detent (midrange) and turn the contrast control to maximum (full clockwise).

---

6. Place the monitor on its side, with the bottom facing you. Use the mirror to view the screen display.
7. FIGURE 7. Using the insulated plastic screwdriver, turn the SUB.BRIGHT control until the first bar (on bottom) is completely black, and the second bar is barely visible.
8. Place the monitor upright and display the all-white screen test pattern.
9. FIGURE 6. Using the light meter, measure the screen luminance. Adjust the VIDEO GAIN control until the screen luminance measures at "11" on the light meter.
10. Turn the brightness control to maximum (full clockwise) and recheck screen luminance.
11. If screen luminance does not measure at the "11" scale on the light meter, repeat the procedure.

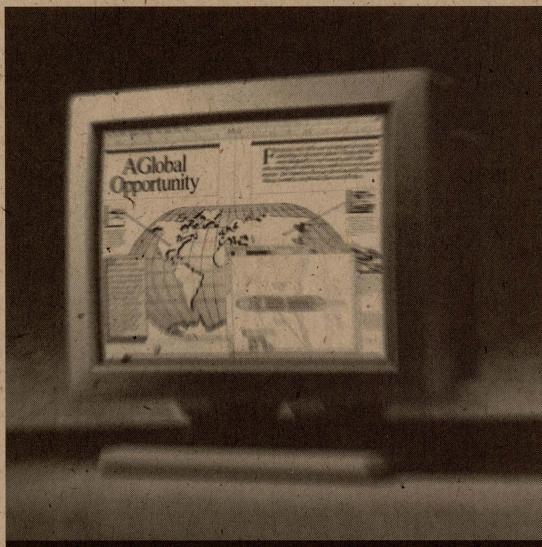
**Bottom View**



**Figure 7 SUB.BRIGHT Control**



# **Apple Two-Page Monochrome Monitor**



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## Illustrated Parts List

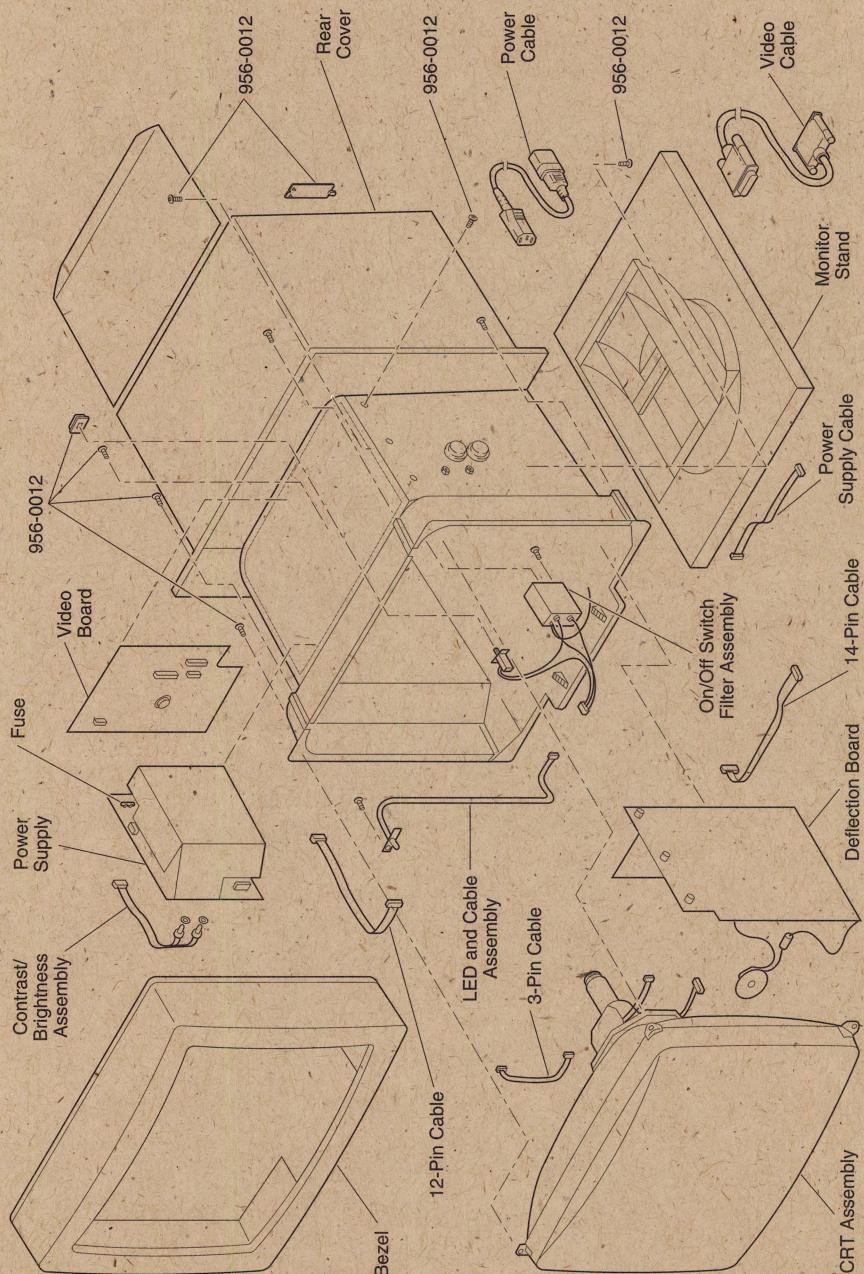


Figure 1 Apple Two-Page Monochrome Monitor Exploded View

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Cables	
Cable, deflection board to video board, 3-pin .....	590-0397
Cable, deflection board to video board, flat, 12-pin .....	590-0395
Cable, deflection board to video board, flat, 14-pin .....	590-0398
Cable, external power.....	590-0371
Cable, LED assembly.....	590-0391
Cable, power supply .....	590-0393
Cable, video, DA-15 to DB-25, CPU to monitor (used with 661-0608).....	590-061
Cable, video, DB-25 to DB-25, CPU to monitor (used with 661-0452).....	590-0574
Case and stand parts	
Bezel.....	949-0223
Rear cover .....	949-0224
Screw/knob set.....	956-0012
Tilt-swivel monitor stand .....	815-0558
CRT assembly (includes yoke assembly) .....	076-0320
Fuse, 2.5 Amp, 250 V, 5/pk .....	941-0016
Linearity adjustment tool (not shown) .....	949-0235
Other component assemblies	
Contrast/brightness assembly .....	905-0007
On/off switch filter assembly.....	937-0040
Power supply.....	661-0453
Printed circuit boards	
Deflection board.....	661-0451
Video board .....	661-0452

---

## Troubleshooting

---

### Symptom/Cure Chart

Use the following chart as a troubleshooting guide. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement. For information on environmental distortions, see the General Monitor Information chapter.

No Raster	Solutions
No raster, LED off	<ol style="list-style-type: none"><li>1. Check that the power cord is properly connected.</li><li>2. Check the internal power connectors.</li><li>3. Check fuse; replace if blown. If it blows again, go to next step.</li><li>4. Replace the power supply.</li><li>5. Replace the on/off switch/filter assembly.</li><li>6. Replace the deflection board.</li></ol>
No raster, LED on	<ol style="list-style-type: none"><li>1. Adjust the brightness and contrast controls.</li><li>2. Verify that the video card (in the CPU) is working properly.</li><li>3. Verify that all connectors are secure on the power supply and deflection board.</li><li>4. Check that the CRT socket connectors are tight.</li><li>5. Replace the video board.</li><li>6. Replace the deflection board.</li><li>7. Replace the CRT and yoke assembly.</li></ol>
<b>Geometric Problems<sup>1</sup></b>	<b>Solutions</b>
Raster size too short/tall, narrow/wide	<ol style="list-style-type: none"><li>1. Adjust vertical and horizontal size controls (as appropriate).</li><li>2. Replace the deflection board.</li><li>3. Replace the CRT and yoke assembly.</li></ol>
Raster not centered	<ol style="list-style-type: none"><li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li><li>2. Adjust the horizontal shift and vertical shift controls.</li><li>3. Replace the video board.</li></ol>
Horizontal linearity bad	<ol style="list-style-type: none"><li>1. Adjust the horizontal linearity control.</li><li>2. Replace the deflection board.</li></ol>
Vertical linearity bad	<ol style="list-style-type: none"><li>1. Adjust the vertical linearity control.</li><li>2. Replace the deflection board.</li></ol>
<b>Synchronization Problems</b>	<b>Solutions</b>
One horizontal or vertical line appears on screen	<ol style="list-style-type: none"><li>1. Verify that the yoke connectors are tight.</li><li>2. Check that the CRT socket connections are tight.</li><li>3. Replace the deflection board.</li><li>4. Replace the CRT and yoke assembly.</li></ol>

---

<sup>1</sup> Remember, slight geometric distortion problems cannot be solved by replacing modules.

---

Picture breaks in diagonal lines	<ol style="list-style-type: none"> <li>1. Connect another monitor to the computer and switch power on to verify that a video signal is coming from the computer.</li> <li>2. Verify that all connections between the video board and the deflection board are secure.</li> <li>3. Replace the deflection board.</li> <li>4. Replace the video board.</li> </ol>
Picture rolls vertically	<ol style="list-style-type: none"> <li>1. Verify that the video card (in the CPU) is working properly.</li> <li>2. Verify that all connectors are secure on the video board and deflection board.</li> <li>3. Replace the deflection board.</li> <li>4. Replace the video board.</li> </ol>
<b>Video Problems</b>	<b>Solutions</b>
Picture is too dark or too bright	<ol style="list-style-type: none"> <li>1. Adjust the contrast and brightness controls.</li> <li>2. Verify that the video card (in the CPU) is working properly.</li> <li>3. Verify that the contrast/brightness connector is properly connected to the video board.</li> <li>4. Perform the video adjustments.</li> <li>5. Replace the video board.</li> <li>6. Replace the contrast/brightness assembly.</li> <li>7. Replace the CRT and yoke assembly.</li> </ol>
Contrast/brightness cannot be adjusted	<ol style="list-style-type: none"> <li>1. Verify that the contrast/brightness connector is properly connected to the video board.</li> <li>2. Replace the contrast/brightness assembly.</li> <li>3. Replace the video board.</li> <li>4. Replace the deflection board.</li> <li>5. Replace the CRT and yoke assembly.</li> </ol>
Out of focus	<ol style="list-style-type: none"> <li>1. Check that the CRT socket connections are tight.</li> <li>2. Verify that all connectors are secure on the video board and deflection board.</li> <li>3. Perform the focus adjustment.</li> <li>4. Check screen brightness with a light meter. If the meter reading is at "10" or higher, perform the cutoff adjustments and then repeat the focus adjustment.</li> <li>5. Replace the video board.</li> <li>6. Replace the deflection board.</li> <li>7. Replace the CRT and yoke assembly.</li> </ol>
<b>Misc. Problems</b>	<b>Solutions</b>
Picture jitters or flashes	<ol style="list-style-type: none"> <li>1. Verify that all grounding cables are secure.</li> <li>2. Confirm that adjacent computer equipment is properly grounded. Move electrical devices away from the monitor. Temporarily shut off all fluorescent lights in the area.<sup>2</sup></li> <li>3. Confirm that all connectors are secure on the video board and the deflection board.</li> <li>4. Replace the deflection board.</li> </ol>

---

<sup>2</sup> External electrical interference problems cannot be solved by monitor adjustments or module replacement.

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## Safety Instructions

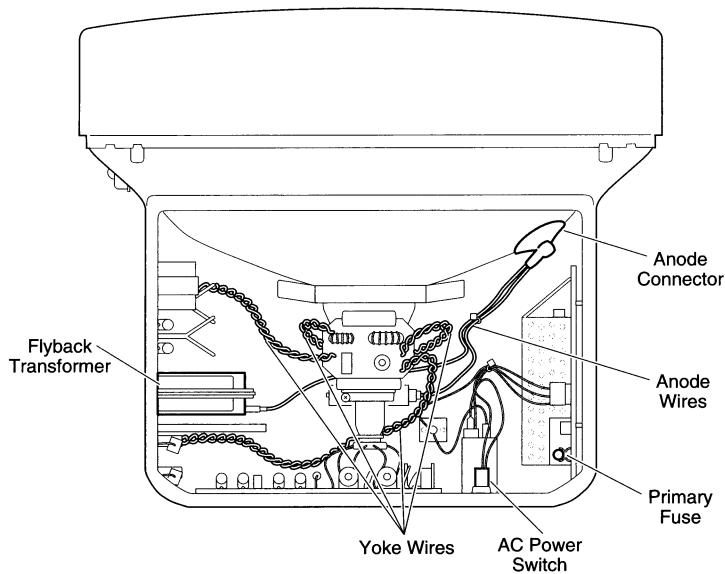
**▲ Warning** The Apple Two-Page Monochrome Monitor contains a high-vacuum picture tube and operates at very high voltages. To prevent serious injury, review the CRT Safety rules in the General Monitor Information chapter.

---

- Keep one hand behind your back at all times, and grasp the handle of the insulated alignment tool with your other hand.
- Use a mirror for viewing adjustment results.
- Perform only those adjustments that are absolutely necessary. Do not attempt to make any adjustments other than the ones explained in this section, and do those with extreme caution.

**▲ Warning** Serious injury could result if, with the power on, you touch any of the high-voltage areas shown in Figure 2.

---



**Figure 2 High-Voltage Areas**

---

## Adjustments

---

### Geometric Adjustments

#### Materials Required

Linearity adjustment tool

Plastic alignment tool

Appropriate diagnostic (See the Monitor Diagnostics table in the General Monitor Information chapter.)

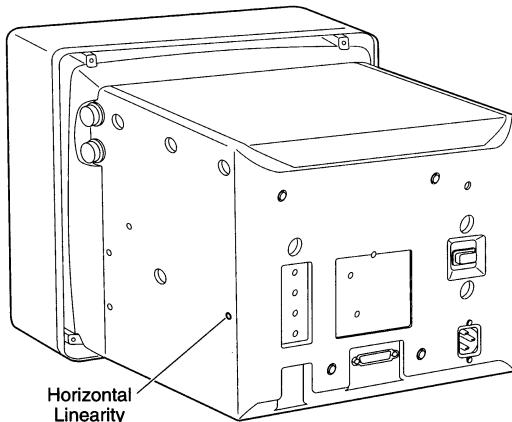
#### Horizontal

1. Remove the rear cover.
2. Boot the diagnostic. Select the crosshatch II test pattern.
3. FIGURE 3. Using the linearity adjustment tool, turn the Horizontal Linearity control until the raster is as wide as possible.

**▲ Caution**

**Use the linearity adjustment tool when adjusting the Horizontal Linearity. Any other tool may damage the adjustment control coil or cause a short in the monitor's circuitry.**

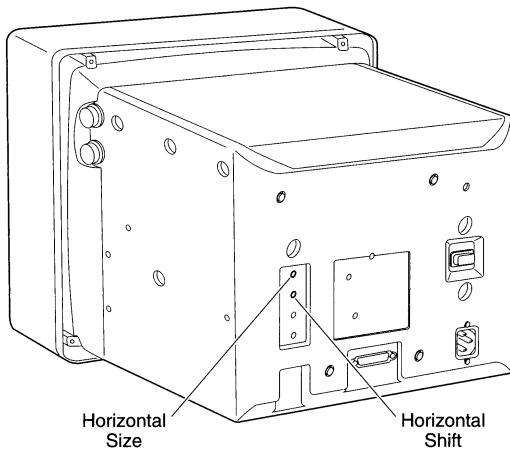
4. FIGURE 3. Slowly turn the Horizontal Linearity control until both the left and right sides of the raster are the same distance from the center of the screen.



**Figure 3 Horizontal Linearity Adjustment**

---

5. FIGURE 4. Using the plastic alignment tool, turn the Horizontal Size control until the raster is 15 inches wide.
6. Verify that the left and right sides of the raster are still the same distance from the center of the screen. If necessary, readjust the Horizontal Linearity control.
7. Check the crosshatch display on the monitor screen. Verify that the boxes on the left and right sides of the screen are the same size as the boxes in the center.



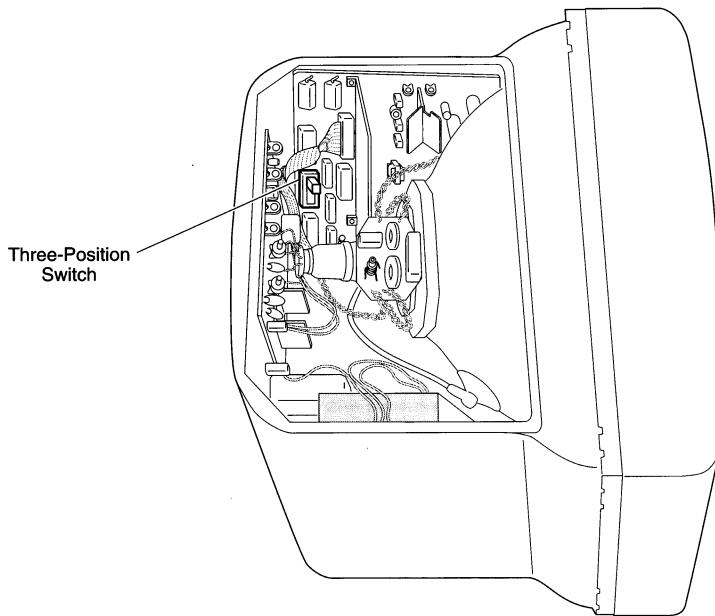
**Figure 4 Horizontal Size and Shift Adjustments**

**▲ Warning**

**The Apple Two-Page Monochrome Monitor operates at extremely high voltages. To prevent electrical shock, use an insulated (nonmetal) tool to set the three-position switch on the main board.**

---

8. FIGURE 5. If the boxes are not the same size, use an insulated (nonmetal) tool to reach inside the monitor chassis and set the three-position switch on the main board for best overall horizontal linearity.
9. Verify that the raster is still 15 inches wide and readjust the Horizontal Size control if necessary.
10. FIGURE 4. Adjust the Horizontal Shift control to center the raster on the monitor screen.



**Figure 5 Three-Position Switch**

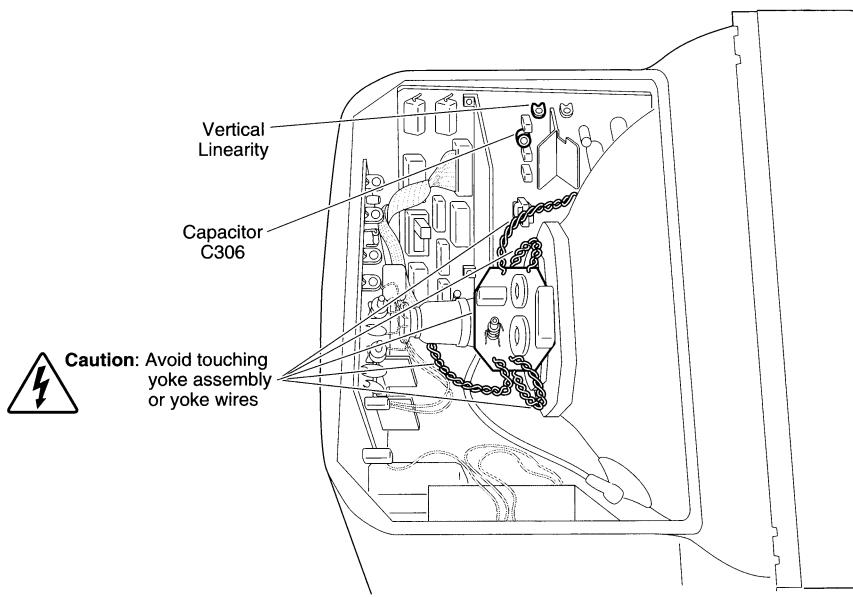
### **Vertical**

1. Remove the rear cover.
2. Boot the diagnostic and select the crosshatch II test pattern.

**▲ Warning**

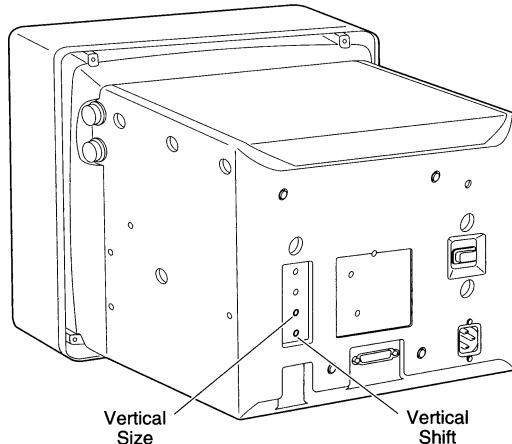
**To prevent electrical shock, do not touch the yoke assembly or any of the yoke wires when performing vertical adjustments.**

3. FIGURE 6. Adjust the small orange capacitor at C306 on the main deflection board until the top two rows of boxes on the monitor screen are the same size.
4. FIGURE 6. Adjust the Vertical Linearity control until the top and bottom rows of boxes are the same size.
5. Select the all-white screen test pattern.



**Figure 6 Vertical Linearity and Capacitor Adjustments**

6. FIGURE 7. Adjust the Vertical Shift control until the raster is centered on the screen.
7. FIGURE 7. Adjust the Vertical Size control until the raster is 11 5/16 inches high.



**Figure 7 Vertical Shift and Size Controls**

---

## Cutoff/Video Adjustments

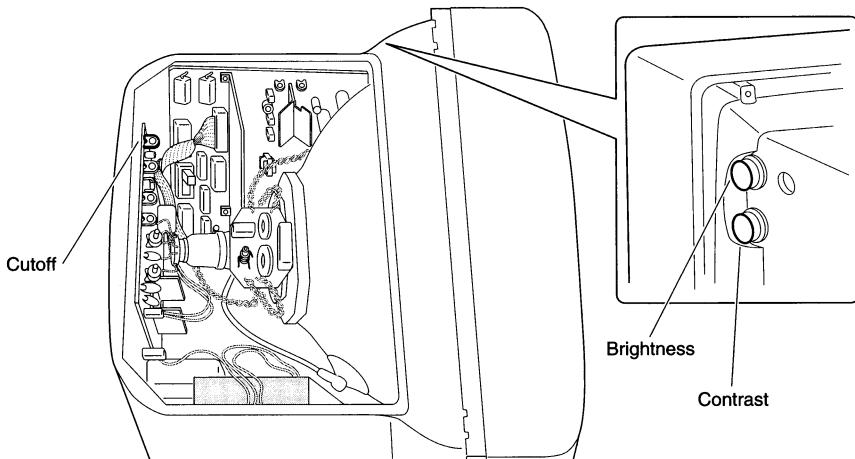
### **Materials Required**

Plastic alignment tool

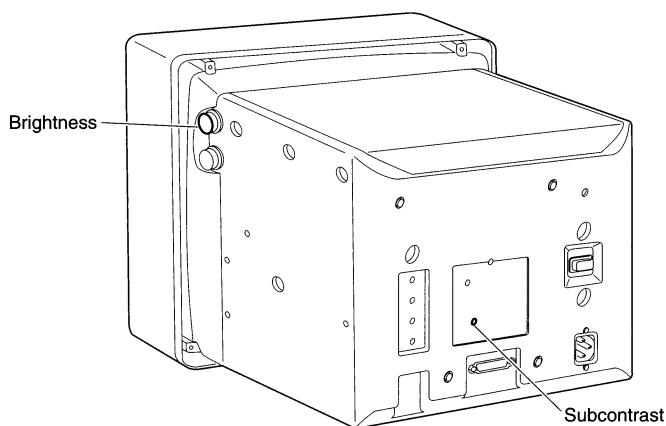
Light meter (Sekonic Multi-Lumi, model L-248)

Appropriate diagnostic (See the Monitor Diagnostics table in the General Monitor Information chapter.)

1. FIGURE 8. Switch off the monitor and remove the video cable. Turn the brightness control to the detent position (midrange) and the contrast control to maximum (full clockwise).
2. FIGURE 8. Turn the Cutoff control full counterclockwise and switch on the monitor. Let the monitor warm up for 20 minutes.
3. FIGURE 8. Turn the Cutoff control clockwise until the raster just fades to black.
4. Switch off the power, reconnect the video cable, and switch on the monitor. Let the monitor warm up for another 20 minutes.
5. Boot the diagnostic and select the gray bars test pattern.
6. FIGURE 8. Adjust the Cutoff control so that bar 1 is completely black and bar 2 is barely visible.

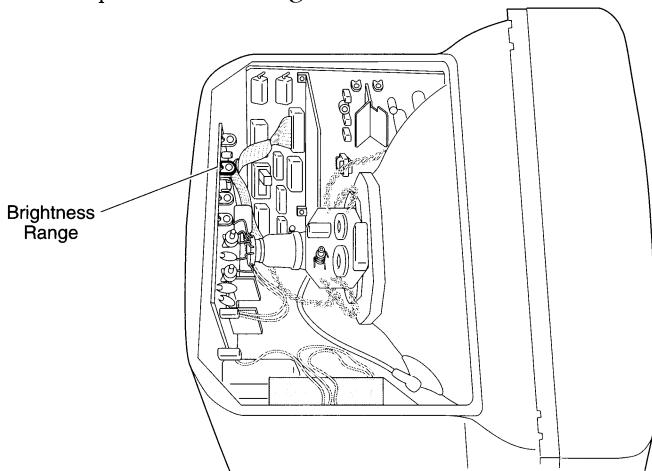


**Figure 8 Brightness, Contrast, and Cutoff Controls**



**Figure 9 Brightness and Subcontrast Controls**

7. FIGURE 9. Select the all-white screen test pattern and measure the screen luminance. Adjust the Subcontrast control until the screen luminance reads at high "9" on the light meter.
8. FIGURE 9. Turn the brightness control to maximum (full clockwise).
9. FIGURE 10. Adjust the Brightness Range control until the luminance at the center of the screen reads at low "10" on the light meter.
10. FIGURE 9. Turn the brightness control to the detent position (midrange).



**Figure 10 Brightness Range Control**

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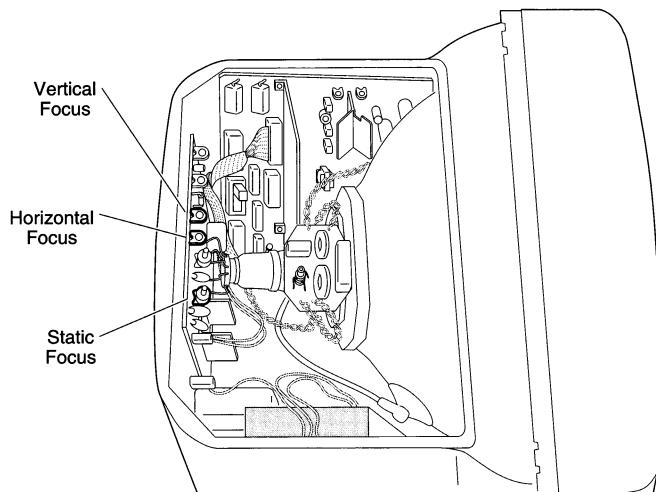
## **Focus Adjustment**

### **Materials Required**

Plastic alignment tool

Appropriate diagnostic (See the Monitor Diagnostics table in the General Monitor Information chapter.)

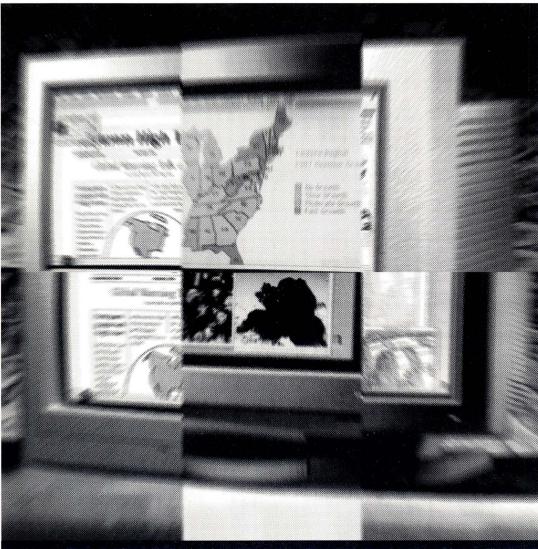
1. Boot the diagnostic and select the focus test pattern.
2. FIGURE 11. Adjust the Static Focus control for best focus at the center of the screen.
3. FIGURE 11. Adjust the Horizontal Focus control for the best focus at the left and right sides of the screen.
4. FIGURE 11. Adjust the Vertical Focus control for the best focus at the top and bottom center of the screen.



**Figure 11 Focus Controls**



## Color Monitors



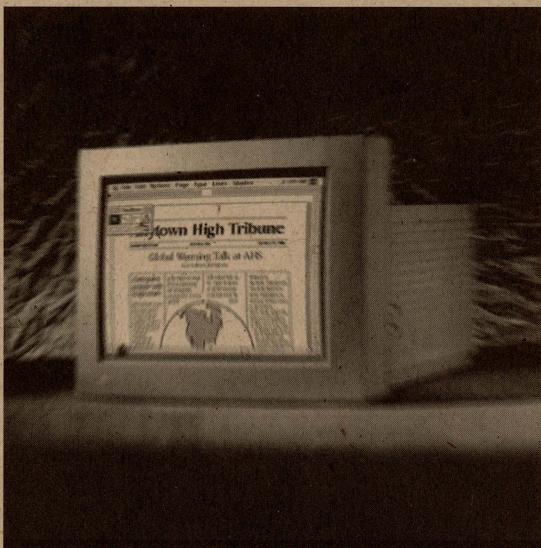
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Color Monitors



# Macintosh 12-Inch RGB Display



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## Illustrated Parts List

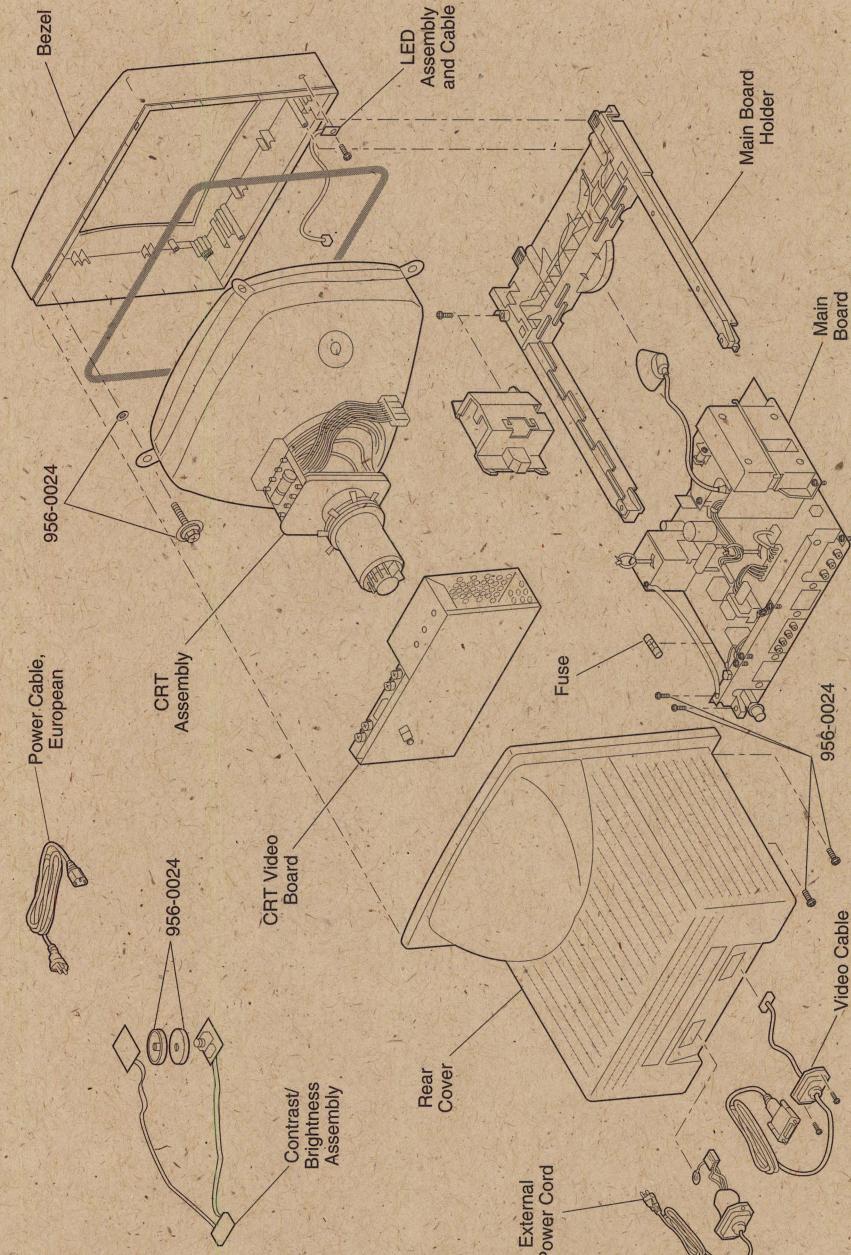


Figure 1 Macintosh 12-Inch RGB Display Exploded View

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Cables	
Cable, external power, domestic .....	590-0370
Cable, external power, European .....	590-0420
Cable, LED assembly.....	930-0008
Cable, video (CPU to monitor) .....	590-0693
Case parts	
Bezel .....	949-0297
Main board holder .....	949-0304
Rear cover, domestic .....	949-0298
Rear cover, international.....	949-0303
Screw/knob set .....	956-0024
CRT assemblies	
CRT assembly, rev. A.....	076-0384
CRT assembly, rev. B .....	076-0395
CRT assembly, Australia .....	076-0386
CRT assembly, Europe.....	076-0385
CRT assembly, international rev. B .....	076-0397
CRT assembly, international rev. B .....	076-0406
CRT assembly, international rev. B .....	076-0396
Fuses	
Fuse, 125 V, 3.15 A, domestic .....	941-5222
Fuse, 250 V, 3.15 A, international .....	941-5223
Other assemblies	
Contrast/brightness assembly.....	905-0009
Contrast/brightness assembly, international .....	905-0010
Printed circuit boards	
CRT video board, domestic .....	661-0618
CRT video board, international .....	661-1618
Main board, rev. A .....	661-0616
Main board, rev. B .....	661-0659
Main board, international rev. A .....	661-0617
Main board, international rev. B .....	661-0660

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## Troubleshooting

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### Symptom/Cure Chart

Use the following chart as a troubleshooting guide. If the first corrective action does not solve the problem, reinstall the original module before proceeding to the next step. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement. For information on environmental distortions, see the General Monitor Information chapter.

No Raster	Solutions
No raster, LED off	<ol style="list-style-type: none"><li>1. Check that the power cord is properly connected.</li><li>2. Check the internal power connectors.</li><li>3. Check fuse; replace if blown. If it blows again, go to next step.</li><li>4. Replace the external power cable assembly.</li><li>5. Replace the main board.</li></ol>
No raster, LED on	<ol style="list-style-type: none"><li>1. Adjust the brightness and contrast controls.</li><li>2. Verify that the video card (in the CPU) is working properly.</li><li>3. Verify that all connectors on the main board and the CRT video board are secure.</li><li>4. Check fuse; replace if blown. If it blows again, go to next step.</li><li>5. Perform the screen adjustment procedure.</li><li>6. Replace the main board.</li><li>7. Replace the CRT video board.</li><li>8. Replace the CRT.</li></ol>
<b>Geometric Problems<sup>1</sup></b>	
Raster size too short/tall, narrow/wide	<ol style="list-style-type: none"><li>1. Adjust vertical height or horizontal width controls (as appropriate) on the main board.</li><li>2. Replace the main board.</li><li>3. Replace the CRT.</li></ol>
Raster not centered	<ol style="list-style-type: none"><li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li><li>2. Adjust horizontal or vertical center controls.</li><li>3. Replace the main board.</li></ol>
Horizontal linearity bad (screen sides differ)	<ul style="list-style-type: none"><li>– Replace the main board.</li></ul>
Vertical linearity bad (screen top and bottom differ)	<ol style="list-style-type: none"><li>1. Adjust vertical linearity control on the main board.</li><li>2. Replace the main board.</li></ol>

---

<sup>1</sup> Remember, slight geometric distortion problems cannot be solved by replacing modules.

---

Raster bows	<ol style="list-style-type: none"> <li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li> <li>2. Check vertical height and center and horizontal height and center adjustment controls.</li> <li>3. Replace the main board.</li> <li>4. Replace the CRT.</li> </ol>
Entire raster is tilted	<ol style="list-style-type: none"> <li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li> <li>2. Adjust the yoke assembly as follows: <ul style="list-style-type: none"> <li>a. Switch off the monitor power and remove the rear cover.</li> <li>b. Loosen the frontmost screw on the neck of the CRT.</li> <li>c. Twist the yoke assembly as appropriate.</li> <li>d. Retighten the screw on the neck of the CRT. (Do not overtighten the screw; you could break the CRT neck.)</li> <li>e. Switch on monitor and check display. Repeat these steps if necessary.</li> </ul> </li> <li>3. Replace the main board.</li> </ol>
Abnormal/distorted raster (other than above)	<ol style="list-style-type: none"> <li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li> <li>2. Verify that all connectors are correctly placed and secure.</li> <li>3. Perform geometric adjustments.</li> <li>4. Replace the main board.</li> <li>5. Replace the CRT video board.</li> <li>6. Replace the CRT.</li> </ol>
<b>Synchronization Problems</b>	<b>Solutions</b>
Picture breaks in diagonal lines	<ol style="list-style-type: none"> <li>1. Connect another monitor to the computer and switch power on to verify that a video signal is coming from the computer.</li> <li>2. Adjust the horizontal hold control on the main board.</li> <li>3. Replace the main board.</li> </ol>
Picture rolls vertically	<ol style="list-style-type: none"> <li>1. Verify that the video card (in the CPU) is working properly.</li> <li>2. Adjust the vertical hold control on the main board.</li> <li>3. Replace the main board.</li> </ol>
Single vertical or horizontal line appears	<ol style="list-style-type: none"> <li>1. Verify that the yoke connector <b>DY</b> is tight.</li> <li>2. Replace the main board.</li> <li>3. Replace the CRT.</li> </ol>
<b>Video/Color Problems</b>	<b>Solutions</b>
Predominant red, blue, or green tint	<ol style="list-style-type: none"> <li>1. Verify that the video cable from the CPU is properly seated in video connector.</li> <li>2. Verify that the video card (in the CPU) is working properly.</li> <li>3. Perform the white balance adjustment.</li> <li>4. Replace the CRT video board.</li> <li>5. Replace the CRT.</li> </ol>

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Picture too dark or too bright	<ol style="list-style-type: none"> <li>1. Adjust the brightness and contrast controls.</li> <li>2. Verify that the video card (in the CPU) is working properly.</li> <li>3. Perform the cutoff and white balance video adjustments.</li> <li>4. Replace the main board.</li> <li>5. Replace the CRT video board.</li> <li>6. Replace the CRT.</li> </ol>
Brightness, contrast, or color cannot be adjusted	<ol style="list-style-type: none"> <li>1. Replace the contrast/brightness assembly.</li> <li>2. Replace the main board.</li> <li>3. Replace the CRT video board.</li> </ol>
Out of focus	<ol style="list-style-type: none"> <li>1. Adjust the focus control.</li> <li>2. Perform the screen adjustment procedure.</li> <li>3. Replace the main board.</li> <li>4. Replace the CRT.</li> </ol>
<b>Misc. Problems</b>	<b>Solution</b>
Intermittent shutdown	<ul style="list-style-type: none"> <li>– Replace the main board.</li> </ul>
Picture jitters or flashes	<ol style="list-style-type: none"> <li>1. Verify that all grounding cables are secure.</li> <li>2. Verify that adjacent computer equipment is properly grounded. Move electrical devices away from the monitor. Temporarily shut off all fluorescent lights in the area.<sup>2</sup></li> <li>3. Replace the main board.</li> </ol>
Flashing or wavy screen	<ol style="list-style-type: none"> <li>1. Crimp the metal connector tabs on the video connector.</li> <li>2. Replace the main board.</li> </ol>
Black spots on screen (burnt phosphor)	<ul style="list-style-type: none"> <li>– Replace the CRT.</li> </ul>

---

<sup>2</sup> External electrical interference problems cannot be solved by monitor adjustments or replacement of modules.

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## Safety Instructions

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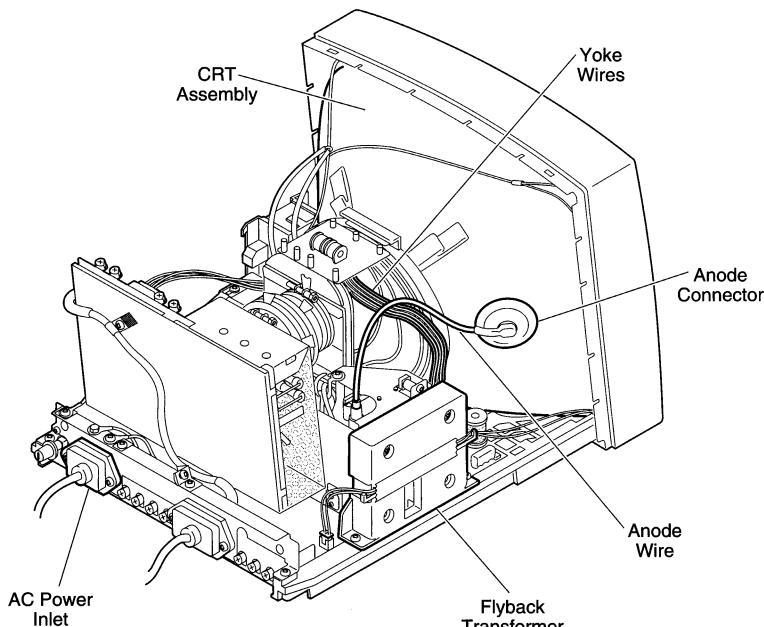
**▲ Warning** The Macintosh 12-Inch RGB Display contains a high-vacuum picture tube and operates at very high voltages. To prevent serious injury, review the CRT Safety rules in the General Monitor Information chapter.

---

- Keep one hand behind your back at all times, and grasp the handle of the insulated alignment tool with your other hand.
- Use a mirror for viewing adjustment results.
- Perform only those adjustments that are absolutely necessary. Do not attempt to make any adjustments other than the ones explained in this section, and do those with extreme caution.

**▲ Warning** Serious injury could result if, with the power on, you touch any of the high-voltage areas shown in Figure 2.

---



**Figure 2 High-Voltage Areas**

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## Adjustments

---

### Geometric Adjustments

#### Materials Required

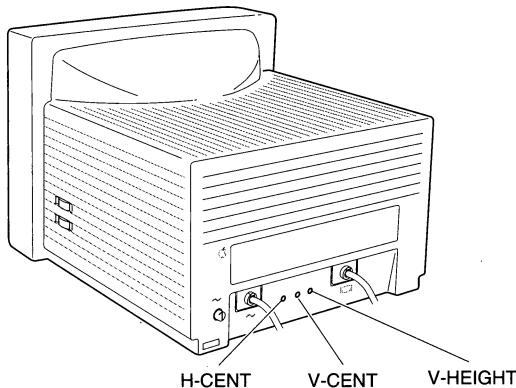
Plastic adjustment tool (insulated screwdriver)  
Mirror  
Flexible metric ruler  
Hex-head, plastic adjustment tool at least six inches long  
Appropriate diagnostic (See the Monitor Diagnostics table in the General Monitor Information chapter.)

#### Vertical Size

1. Display the all-white screen test pattern.
2. FIGURE 3. Turn the V-HEIGHT control (VR404) until the raster is 153 mm ( $\pm$  2 mm) or 6 1/16" ( $\pm$  1/16") high.

#### Vertical Center

1. Display the all-white screen test pattern.
2. FIGURE 3. Turn the V-CENT control (VR403) until the raster is positioned in the approximate center of the screen.



**Figure 3 Size and Centering Controls**

#### Horizontal Center

1. Display the all-white screen test pattern.
2. FIGURE 3. Turn the H-CENT control (VR503) until the raster is positioned in the center of the screen. If the raster cannot be positioned in the center of the screen, set the H-CENT control at midrange and continue with step 3.

---

3. Switch off the monitor and remove the rear cover.
4. FIGURE 4. Turn the H-PHASE control (VR501) until the raster is positioned at the visual midpoint of the range of the H-PHASE control.

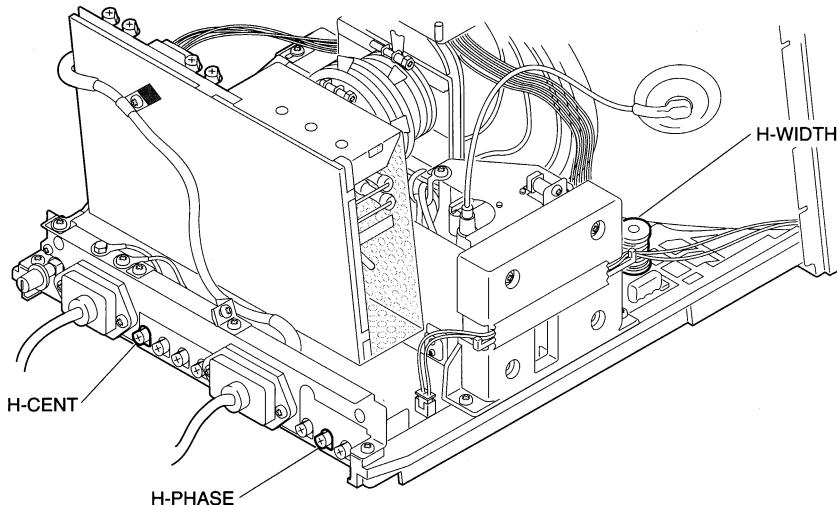
**Note**

To locate the visual midpoint of the range of the H-PHASE control, locate the left and right limits of the control and note the position of the raster at each limit (you will see a thin white band at the limits). Then adjust the H-PHASE control until the raster is positioned at the visual midpoint between the limits.

5. FIGURE 4. Turn the H-CENT control (VR503) until the raster is positioned in the approximate center of the screen.

### **Horizontal Size**

1. Switch off the monitor, remove the rear cover, and switch on the monitor.
2. Display the all-white screen test pattern.
3. FIGURE 4. Using the hex-head insulated adjustment tool, turn the H-WIDTH control (L501) until the raster is 205 mm ( $\pm$  2 mm) or 8 3/32" ( $\pm$  1/16") wide.



**Figure 4 Horizontal Centering and Size Controls**

---

## **Vertical Linearity**

1. Display the crosshatch I test pattern.
2. FIGURE 5. Turn the V-LIN control (VR402) so that the distance between the horizontal lines is the same at the top and bottom of the screen.

## **Vertical Hold**

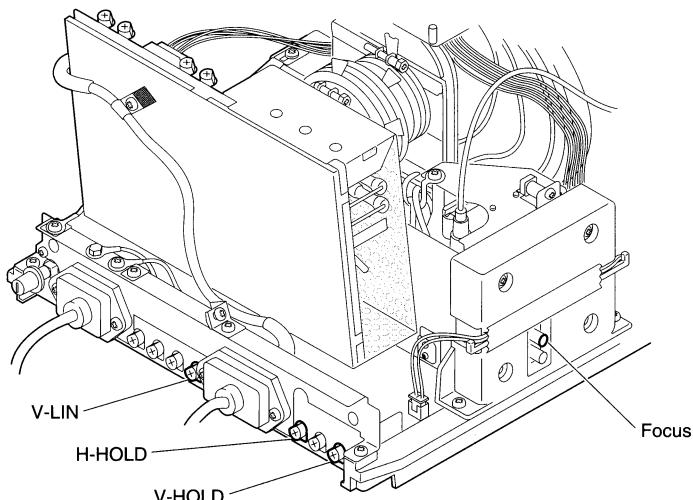
1. Display the all-white screen test pattern.
2. FIGURE 5. Turn the V-HOLD control (VR401) until the raster stabilizes. To check the adjustment, switch the monitor off and then on. If the raster stabilizes immediately, the V-HOLD is correctly set.

## **Horizontal Hold**

- FIGURE 5. Turn the H-HOLD control (VR502) until the raster stabilizes. To check the adjustment, switch the monitor off and then on. If the raster stabilizes immediately, the H-HOLD is correctly set.

## **Focus**

1. Display the focus test pattern.
2. FIGURE 5. Turn the FOCUS control on the flyback transformer until the focus test pattern is as clear as possible.



**Figure 5 Linearity, Hold, and Focus Adjustment Controls**

---

## **Screen Adjustment**

Perform the screen adjustment procedure if one or more of the following conditions is true:

- You have replaced the main board
- The screen adjustment has been altered
- You have replaced the CRT/yoke assembly with a CRT/yoke assembly from a different vendor

### **Materials Required**

High-voltage probe

Voltmeter

Plastic alignment tool

Hex-head, plastic adjustment tool at least six inches long

Mirror

Flexible ruler

Light meter (Sekonic Multi-Lumi, model L-248)

Appropriate diagnostic (See the Monitor Diagnostics table in the General Monitor Information chapter.)

### **Setting Up the Voltmeter and High-Voltage Probe**

1. Switch on voltmeter power and set the voltmeter to the 2 VDC setting.

**▲ Caution**

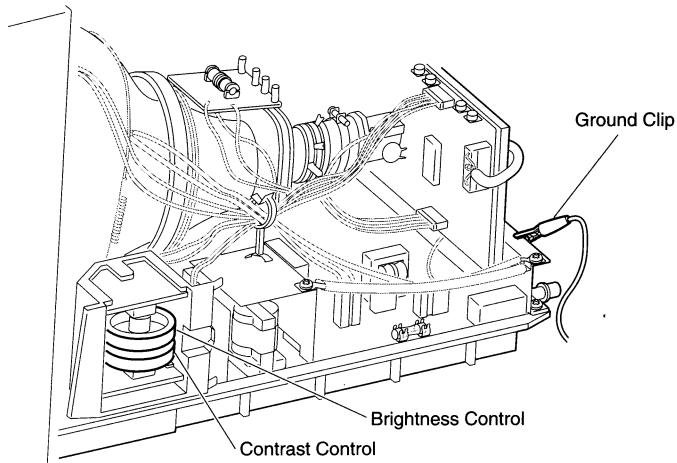
**You must use a high-voltage probe of the type recommended by Apple (part number 076-0392) or you could damage the monitor. Use only high-voltage probes that meet these specifications:**

- Are rated for 40 KV (VDC)
- Have an input impedance of 1,000 megohms
- Have banana clips to plug into a voltmeter
- Have an alligator clip to connect to ground

2. Connect the two-pronged connector of the high-voltage probe to the voltmeter as follows:
  - a. Insert the side of the connector with the plastic ground tab into the socket labeled "Common."
  - b. Insert the other side of the connector into the socket marked "Volts" or " $\Omega$ ."

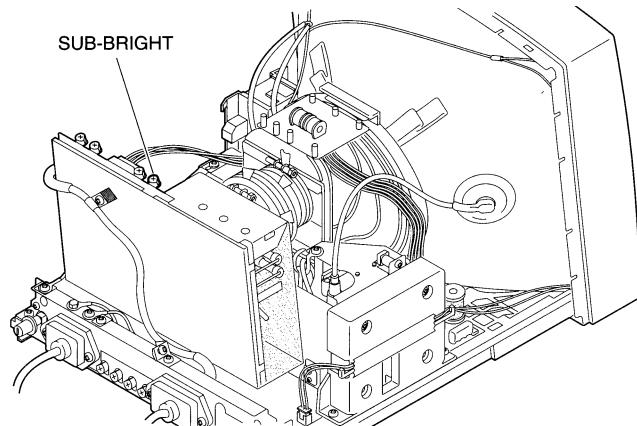
### **Adjustment Procedure**

1. Switch off the monitor, remove the rear cover, and switch on the monitor. Let the monitor warm up for at least 10 minutes.



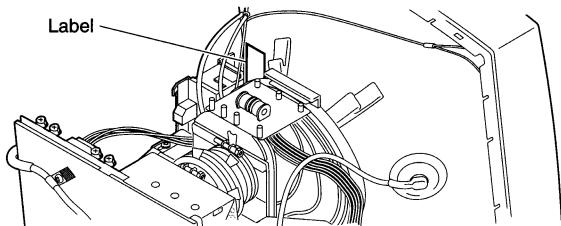
**Figure 6 Brightness and Contrast Controls**

2. FIGURE 6. Attach the high-voltage probe ground clip to the metal monitor chassis.
3. FIGURE 6. Turn the brightness control to detent (midrange) and the contrast control to maximum (turn the knob away from the screen).
4. Display the all-black screen test pattern.
5. FIGURE 7. Turn the SUB-BRIGHT control (VR202) all the way down (counterclockwise).



**Figure 7 SUB-BRIGHT Control**

6. Make sure the ground clip from the high-voltage probe is attached to the metal monitor chassis.



**Figure 8 Determining Monitor Type**

7. FIGURE 8. Locate the label on the side of the CRT and determine which type of monitor you have.

- CRT type AT12A9SLB
- CRT type M29JMN097X13

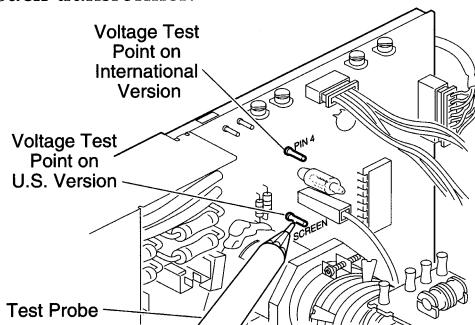
**▲ Warning**

**The next step requires that you measure voltages in excess of 500 volts DC. Be sure to use the high-voltage probe correctly. Take care not to cause a short between the test point (SCREEN or PIN 4) and adjacent components when using the test probe.**

8. FIGURE 9. Touch the high-voltage probe to the voltage test point on the CRT video board labeled SCREEN (U.S. version) or PIN 4 (international version), and read the output at the voltmeter. The reading should be:

- .500 V ( $\pm .005$  V) for CRT AT12A9SLB
- .400 V ( $\pm .004$  V) for CRT M29JMN097X13

If the reading is off, adjust the SCREEN control on the flyback transformer.

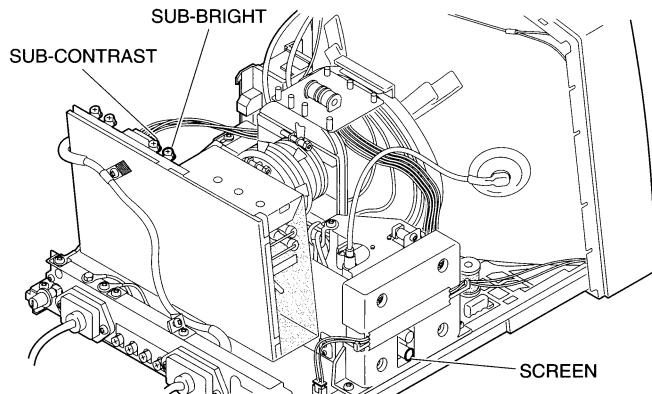


**Figure 9 Voltage Test Points**

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9. Remove and disconnect the high-voltage probe from the monitor.
10. Display the gray bars test pattern.
11. FIGURE 10. Turn up (clockwise) the SUB-BRIGHT (VR202) control until the raster is visible.
12. FIGURE 10. Adjust the SUB-BRIGHT (VR202) control until the first bar of the test pattern is black and the second bar is barely visible.
13. Display the all-white screen test pattern.
14. Set your light meter (Sekonic Multi-Lumi, model L-248) for the 10-to-18 range and check the luminance at the center of the screen. The reading should be at the top of the "10" scale.
15. FIGURE 10. If the reading is incorrect, adjust the SUB-CONTRAST control (VR201) until the luminance at the center of the screen reads at the top of the "10" scale on the light meter.

If you cannot adjust the SUB-CONTRAST control for a correct reading, perform the white balance adjustment.



**Figure 10 SUB-BRIGHT, SUB-CONTRAST, and SCREEN Controls**

---

## **White Balance Adjustment**

Perform all necessary geometric adjustments before performing the white balance adjustments.

### **Materials Required**

Insulated screwdriver

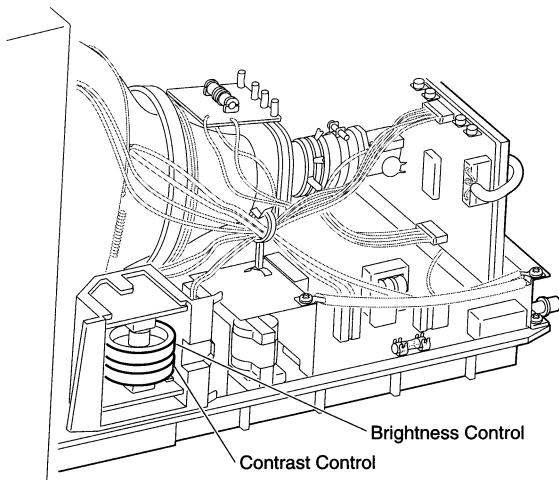
Light meter (Sekonic Multi-Lumi, model L-248)

Voltmeter

Appropriate diagnostic (See the Monitor Diagnostics table in the General Monitor Information chapter.)

**Important** **Perform the white balance adjustment in a dimly lit room after the monitor has been on for at least 10 minutes.**

1. Switch off the monitor, remove the rear cover, and switch on the monitor. Let the monitor warm up for 10 minutes.
2. Display the all-black screen test pattern.
3. FIGURE 11. Set the brightness and contrast controls to maximum (turn the knobs away from the screen).



**Figure 11 Brightness and Contrast Controls**

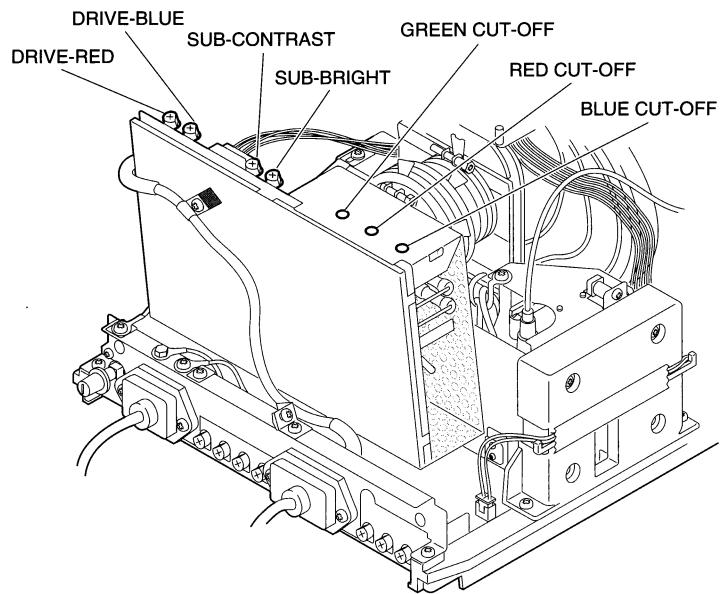
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4. FIGURE 12. Preset the following adjustment controls:
  - GREEN, RED, and BLUE CUT-OFF controls to minimum brightness (turn counterclockwise)
  - DRIVE-RED and DRIVE-BLUE controls to midrange
  - SUB-CONTRAST control (VR201) to midrange
5. FIGURE 12. Adjust the SUB-BRIGHT control (VR202) counterclockwise until you cannot see the raster, and then turn the SUB-BRIGHT control clockwise until the raster is visible.
6. FIGURE 12. Adjust the GREEN CUT-OFF control until green is the predominant color on the screen. (The entire screen should be obviously tinted green, but dark.)
7. Display the gray bars test pattern and set the brightness control to the detent position.
8. FIGURE 12. Alternately adjust the RED and BLUE CUT-OFF controls until the left three bars display no predominant color (no colored tint).
9. FIGURE 12. Turn the SUB-BRIGHT control (VR202) counterclockwise until the left-most bar is as black as the screen border.

**Note**

If you cannot turn the SUB-BRIGHT control so that the left-most bar is as black as the screen border, stop the adjustment procedure and repair the monitor.

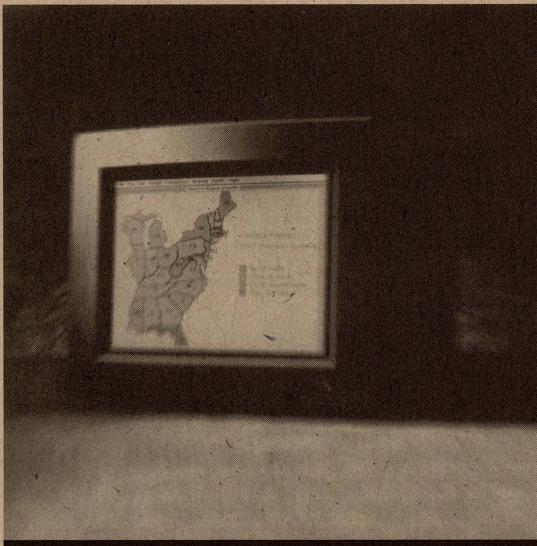
10. If there is no predominant color in any of the gray bars, go to step 13 and set screen luminance. If there is a predominant color (colored tint) in the right (brightest) three bars, proceed with the next step.
11. FIGURE 12. Alternately adjust the two drive controls—DRIVE-RED and DRIVE-BLUE—until there is no predominant color in the right three bars.
12. If there is now a predominant color in the left three bars, return to step 2 and repeat the white balance adjustments. If there is no predominant color in the three left bars, go to the next step.
13. Display the all-white screen test pattern.
14. Set your light meter (Sekonic Multi-Lumi, model L-248) for the 10-to-18 range.
15. FIGURE 12. Adjust the SUB-CONTRAST control (VR201) until the center of the all-white screen measures at the top of the "10" scale on the light meter.



**Figure 12** Video Adjustment Controls



# **AppleColor High-Res RGB Monitor**



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## Illustrated Parts List

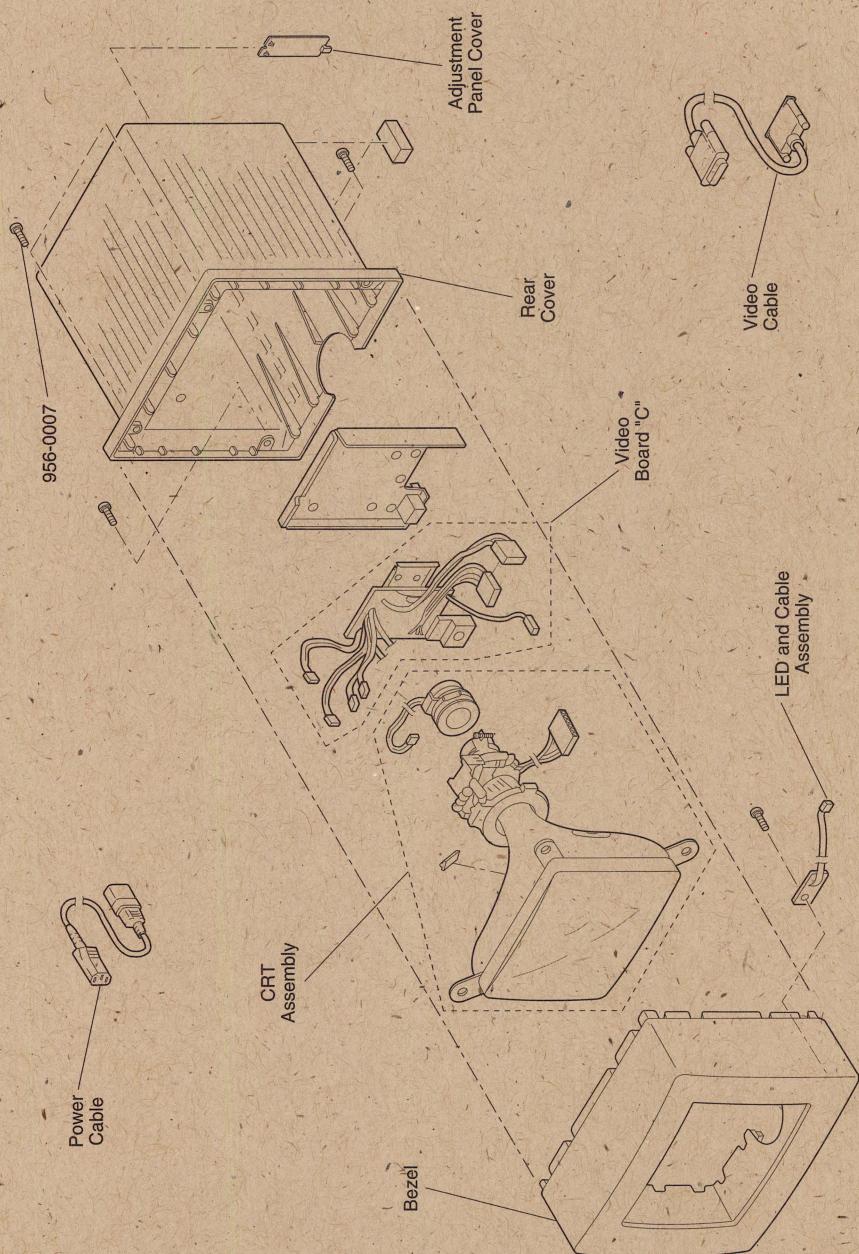
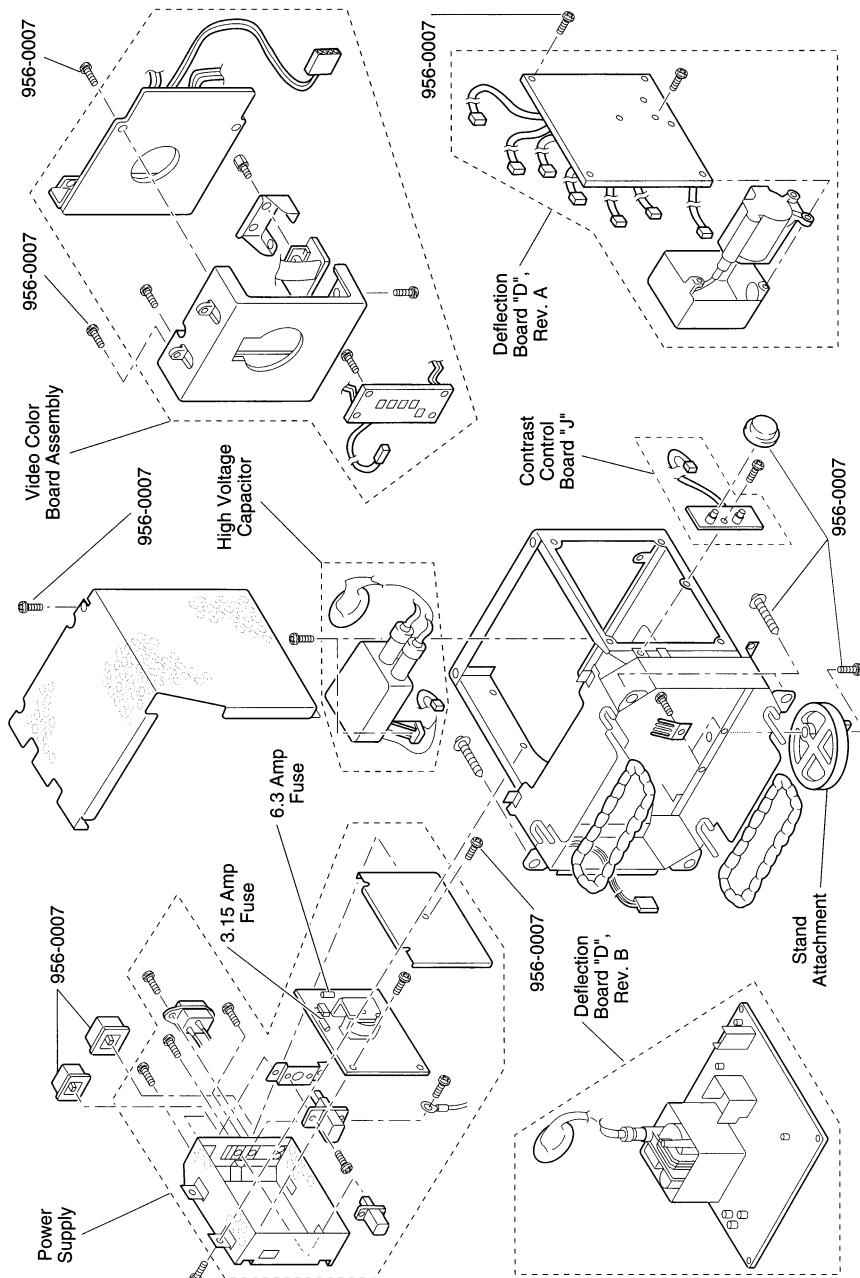


Figure 1 AppleColor High-Res RGB Monitor Exploded View



**Figure 2 AppleColor High-Res RGB Monitor Exploded View**

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Cables	
Cable, external power, domestic .....	590-0372
Cable, external power, Europe .....	590-0422
Cable, LED assembly .....	590-0439
Cable, video (CPU to monitor) .....	590-4161
Case parts	
Adjustment panel cover.....	949-0127
Bezel.....	949-0113
Rear cover .....	949-0114
Screw/knob set .....	956-0007
Stand attachment.....	949-0115
CRT assemblies	
CRT assembly, rev. A .....	076-0245
CRT assembly, rev. B.....	076-0393
CRT assembly, rev. B, Australia .....	076-0407
CRT assembly, rev. B, Europe, Japan .....	076-0409
CRT assembly, rev. B, Scandinavia .....	076-0408
Fuses	
Fuse, 250 V, 3.15 Amp (F102).....	740-0108
Fuse, 250 V, 6.3 Amp (F101).....	740-0109
High-voltage capacitor, rev. A .....	910-0058
Power supply, rev. B .....	661-0705
Printed circuit boards	
Contrast control board "J," rev. B .....	905-0012
Deflection board "D," rev. A .....	661-0399
Deflection board "D," rev. B .....	661-0654
Video board "C," rev. B .....	982-0077
Video color board assembly "B," rev. B .....	661-0653

---

## Troubleshooting

---

### Symptom/Cure Chart

Use the following chart as a troubleshooting guide. If the first corrective action does not solve the problem, reinstall the original module before proceeding to the next step. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement. For information on environmental distortions, see the General Monitor Information chapter.

No Raster	Solutions
No raster, LED off	<ol style="list-style-type: none"><li>1. Check that the power cord is properly connected.</li><li>2. Check the internal power connectors.</li><li>3. Check fuse; replace if blown. If it blows again, go to next step.</li><li>4. If the deflection board is a rev. A board, replace the high-voltage capacitor.</li><li>5. Replace the deflection board "D."</li><li>6. Replace the power supply.</li></ol>
No raster, LED on	<ol style="list-style-type: none"><li>1. Adjust the contrast and brightness controls.</li><li>2. Verify that all connectors on the power supply and deflection board "D" are secure.</li><li>3. Verify that the video card (in the CPU) is working properly.</li><li>4. Replace the video board "C."</li><li>5. Replace the video color board assembly "B."</li><li>6. Replace the CRT.</li></ol>
<b>Geometric Problems<sup>1</sup></b>	<b>Solutions</b>
Raster size small/ large, short/tall, narrow/wide <sup>2</sup>	<ol style="list-style-type: none"><li>1. Adjust the horizontal or vertical size controls.</li><li>2. Replace the deflection board "D."</li><li>3. Replace the CRT.</li></ol>
Raster not centered	<ol style="list-style-type: none"><li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li><li>2. Adjust the horizontal or vertical shift controls (as appropriate).</li><li>3. Replace the deflection board "D."</li></ol>
Vertical linearity bad (screen top and bottom differ)	<ol style="list-style-type: none"><li>1. Adjust V.LIN control.</li><li>2. Replace the deflection board "D."</li></ol>
Raster fades in and out	– Replace video board "C."

---

1 Remember, slight geometric distortion problems cannot be solved by replacing modules.

2 A thin, gray, horizontal line may be visible across the bottom third of a lit screen. This line is inherent to the design of the monitor and is not a video, CPU, or video card problem.

---

Abnormal/distorted raster: <ul style="list-style-type: none"> <li>• barrel-shaped</li> <li>• corners not square</li> <li>• stretched or compressed at top of display</li> <li>• sides not perpendicular</li> </ul>	<ol style="list-style-type: none"> <li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li> <li>2. Make sure that all connectors are correctly placed and secure.</li> <li>3. Perform the appropriate geometric adjustments.</li> <li>4. Replace the deflection board "D."</li> </ol>
---	--

## Synchronization Problems

Picture breaks in diagonal lines	<b>Solutions</b> <ol style="list-style-type: none"> <li>1. Connect another monitor to the computer and switch power on to verify that a video signal is coming from the computer.</li> <li>2. Replace the deflection board "D."</li> </ol>
Picture rolls vertically	<ol style="list-style-type: none"> <li>1. Connect another monitor to the computer and switch power on to verify that a video signal is coming from the computer.</li> <li>2. Verify that the video card (in the CPU) is working properly.</li> <li>3. Replace the deflection board "D."</li> </ol>
Single vertical line appears	<ol style="list-style-type: none"> <li>1. Make sure that the yoke connectors are tight.</li> <li>2. Replace the deflection board "D."</li> <li>3. Replace the CRT.</li> </ol>
Single horizontal line appears <sup>3</sup>	<ol style="list-style-type: none"> <li>1. Make sure that the yoke connectors are tight.</li> <li>2. Replace the deflection board "D."</li> <li>3. Replace the CRT.</li> </ol>

## Video/Color Problems

Predominant red, blue, or green color tint	<b>Solutions</b> <ol style="list-style-type: none"> <li>1. Verify that the video card (in the CPU) is working properly.</li> <li>2. Verify that cable connections are tight between the monitor and CPU.</li> <li>3. Perform the white balance adjustment procedure.</li> <li>4. Replace the video color board assembly "B."</li> <li>5. Replace the CRT.</li> </ol>
Picture too dark or too bright	<ol style="list-style-type: none"> <li>1. Adjust the brightness and contrast controls.</li> <li>2. Verify that the video card (in the CPU) is working properly.</li> <li>3. Perform the cutoff adjustment procedure.</li> <li>4. Perform the white balance adjustment procedure.</li> <li>5. Replace the video color board assembly "B."</li> <li>6. Replace the deflection board "D."</li> </ol>

---

<sup>3</sup> When using the Rev. A version of the High-Res RGB Monitor with a Macintosh LC, the width of the raster/image area is reduced 3/16 inch from both sides of the screen. Adjust the horizontal size.

---

Brightness cannot be adjusted	1. Replace the video color board assembly "B." 2. Replace the contrast control board "J."
Contrast cannot be adjusted	1. Replace the video color board assembly "B." 2. Replace the contrast control board "J."
Picture out of focus <sup>4</sup>	1. Adjust the focus control. 2. Replace the deflection board "D." 3. Replace the video color board assembly "B." 4. Replace the CRT.
Picture out of focus, with color-shadowed characters <sup>4</sup>	1. Perform the convergence adjustment procedure, then adjust the focus control, if necessary. 2. Replace the deflection board "D." 3. Replace the CRT.
Focus cannot be adjusted	1. Replace the deflection board "D." 2. Replace video board "C." 3. Replace the video color board assembly "B." 4. Replace the CRT.
<b>Misc. Problems</b>	<b>Solutions</b>
Intermittent shutdown	1. If the deflection board is a rev. A board, replace the high-voltage capacitor. 2. Replace the deflection board "D."
Picture jitters or flashes	1. Verify that all ground cables are secure. 2. Verify that adjacent computer equipment is properly grounded. Move electrical devices away from the monitor. <sup>5</sup> Temporarily shut off all fluorescent lights in the area. 3. Replace the deflection board "D."
Black screen spots (burnt phosphor)	– Replace the CRT.
Monitor emits high-pitched noise	– Replace the deflection board "D."
Degauss does not work (uneven patches of color)	– Replace the power supply.

---

<sup>4</sup> Colors in the crosshatch pattern indicate a convergence problem. (If you cannot see any colors and the display is fuzzy or the characters on the focus pattern are unclear, the problem is focus rather than convergence.)

<sup>5</sup> External electrical interference problems cannot be solved by monitor adjustments or replacement of modules.

---

## Safety Instructions

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**▲ Warning** The AppleColor™ High-Res RGB Monitor contains a high-vacuum picture tube and operates at very high voltages. To prevent serious injury, review the CRT safety rules before performing adjustments.

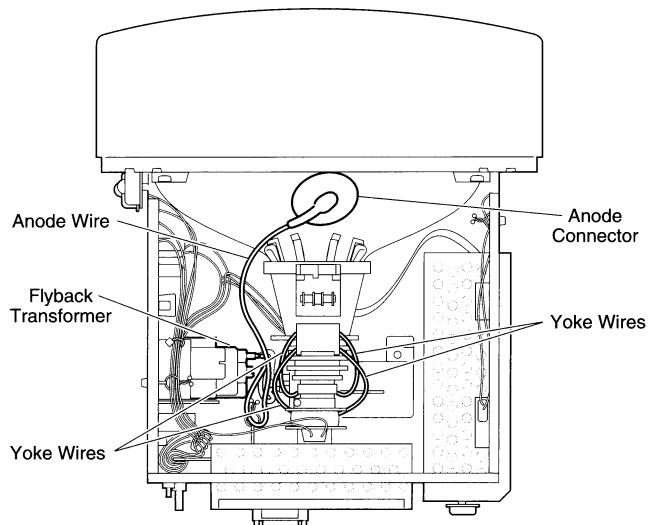
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In addition to following all safety precautions, be sure to:

- Keep one hand behind your back at all times, and grasp the handle of the insulated alignment tool with your other hand.
- Use a mirror for viewing adjustment results.
- Perform only those adjustments that are absolutely necessary. Do not attempt to make any adjustments other than the ones explained in this section, and do those with extreme caution.

**▲ Warning** Serious injury could result if, with the power on, you touch any of the high-voltage areas shown in Figure 3.

---



**Figure 3 High-Voltage Areas**

---

## Adjustments

---

### Geometric Adjustments

#### Materials Required

Plastic adjustment tool or insulated screwdriver

Flexible metric ruler

Appropriate diagnostic (See the Monitor Diagnostics table in the General Monitor Information chapter.)

**Important** Always adjust the horizontal size before you adjust the vertical size. The horizontal size adjustment can affect the height of the raster.

#### Horizontal Size

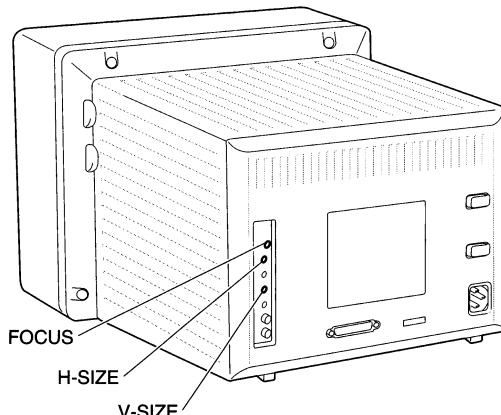
1. Using the diagnostic, display the crosshatch II test pattern.
2. FIGURE 4. Turn the H-SIZE control until the raster is 235 mm wide.

#### Vertical Size

1. Display the crosshatch II test pattern.
2. FIGURE 4. Turn the V-SIZE control until the raster is 176 mm high.

#### Focus

1. Display the focus test pattern.
2. FIGURE 4. Turn the FOCUS (RV701) control for the best focus at the center of the screen.



**Figure 4** Size and Focus Controls

---

## Video Adjustments

### Materials Required

Insulated screwdriver

Voltmeter

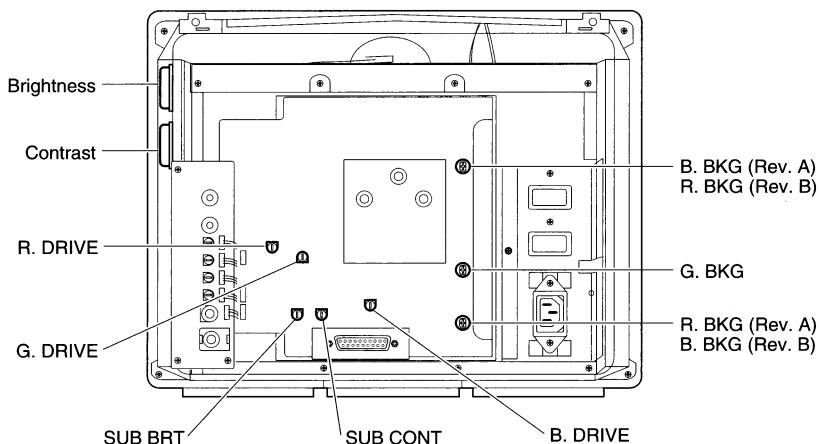
Light meter (Sekonic Multi-Lumi, model L-248)

Appropriate diagnostic (See the Monitor Diagnostics table in the General Monitor Information chapter.)

**Important** Perform the cutoff and white balance adjustments in a dimly lit room after the monitor has been on for at least 10 minutes.

### Cutoff

1. Switch off the monitor, remove the video cable, and switch on the monitor. Let the monitor warm up for 10 minutes.
2. FIGURE 5. Turn the brightness control to detent (midrange) and turn the contrast control to maximum (turn clockwise).
3. FIGURE 5. Set the eight controls on the video color ("B") board to midrange.
4. Set the voltmeter to measure DC voltage of 140 volts. Attach the voltmeter ground lead (black lead) to the monitor chassis.



**Figure 5 Brightness, Contrast, and "B" Board Controls**

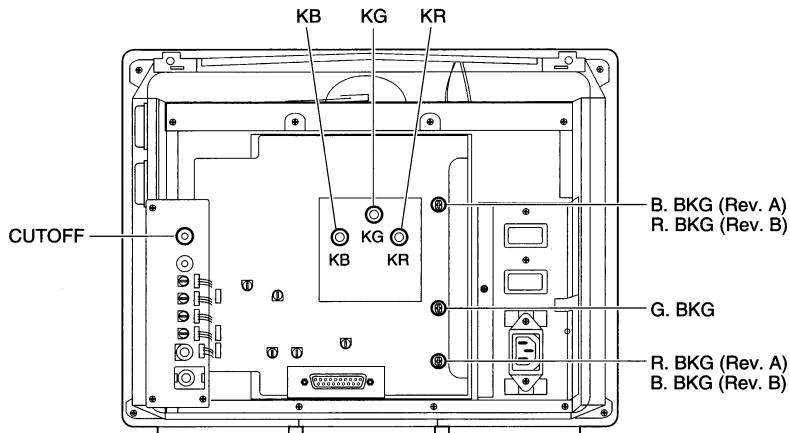
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5. FIGURE 6. Place the voltmeter red lead at KR on the video ("C") board. Gradually turn the R.BKG control until the DC voltage at KR measures 140 volts  $\pm$  2 volts.
6. FIGURE 6. Place the voltmeter red lead at KG on the "C" board. Turn the G.BKG control until the DC voltage at KG measures 140 volts  $\pm$  2 volts.
7. FIGURE 6. Place the voltmeter red lead at KB on the "C" board. Turn the B.BKG control until the DC voltage at KB measures 140 volts  $\pm$  2 volts.
8. FIGURE 6. Turn the CUTOFF control clockwise until the screen raster is just visible. Then turn the CUTOFF control counterclockwise until the raster disappears completely. If you are unable to complete this step, stop the adjustment procedure and repair the monitor.

▲ Caution

**If the cutoff is set too high, the monitor may shut down. If this happens, switch off the monitor, turn the CUTOFF control all the way down (counterclockwise), and wait 30 seconds. Then switch on the monitor and continue the adjustment.**

9. Perform the white balance adjustment.



**Figure 6 Cutoff, Color Background, and "C" Board Controls**

## White Balance

**▲ Caution** Make sure the CUTOFF control is properly set before you perform the white balance adjustment. The life of the monitor may be severely reduced if the cutoff is not set correctly.

1. Connect the video cable to the monitor and switch on the monitor. Let the monitor warm up for 10 minutes.
2. Display the gray bars test pattern.
3. FIGURE 7. Alternately adjust the B.BKG, G.BKG, and R.BKG controls so that:
  - Bars 1, 2, and 3 have no predominant color
  - Bar 1 is completely black (same as screen border)
  - Bar 2 is barely visible
  - Bar 3 is dark gray
4. FIGURE 7. Adjust the G.DRIVE control until the center of bar 8 (the brightest bar) measures at the mid "9" scale of the light meter.
5. FIGURE 7. Now adjust the R.DRIVE and B.DRIVE controls until there is no predominant color in the test pattern. Repeat steps 4 and 5 as necessary.

**Note**

If there is no predominant color, bar 8 measures at mid "9" on the light meter, and bars 1, 2, and 3 are black, barely visible, and dark gray, the white balance is properly adjusted. If minor adjustments are still required, perform steps 6 and 7.

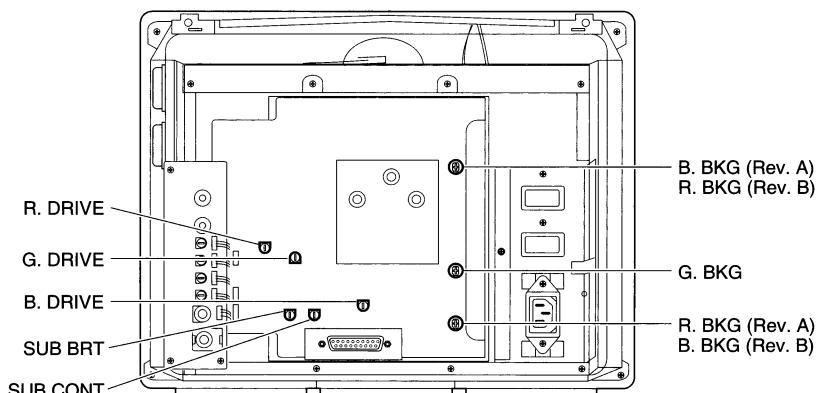


Figure 7 White Balance Controls

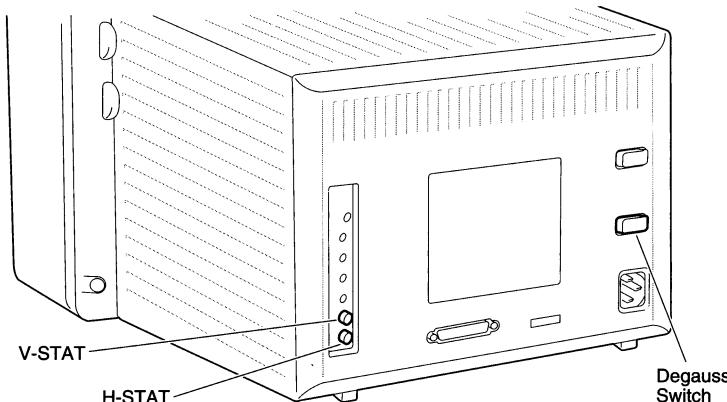
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6. FIGURE 7. Adjust the SUB CONT control so that the brightness at the center of bar 8 measures at mid "9" on the light meter.
7. FIGURE 7. Adjust the SUB BRT control so that bar 1 is completely black and bar 2 is barely visible.

### Convergence

**▲ Caution** **This adjustment differs from geometric convergence, which is a factory adjustment of the magnets on the yoke of the CRT. Do not attempt to set convergence by tampering with the yoke magnets!**

1. Switch on the monitor and let the monitor warm up for 15 to 20 minutes.
2. Display the crosshatch I test pattern.
3. Check the crosshatch lines on the test pattern for the following conditions:
  - If the lines are pure white, the color convergence does not need adjusting.
  - If the lines show any colored shadows, go to step 4.
4. FIGURE 8. Press the degauss switch and remove the service panel cover.
5. FIGURE 8. Turn the V-STAT control until the color-shadowed horizontal lines blend to solid white lines.
6. FIGURE 8. Turn the H-STAT control until the color-shadowed vertical lines blend to solid white lines. If you are unable to remove the shadowed lines, go to step 7.

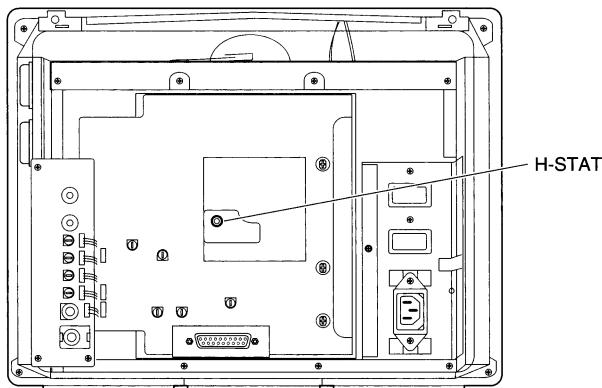


**Figure 8 Convergence Controls**

---

**Important** **Perform the next step only if you cannot adjust the horizontal convergence using the H-STAT control.**

7. If the vertical lines still show color shadows, switch off the monitor. Remove the monitor cover, the EMI shield, and the metal video board shield.
8. Boot the diagnostic and display crosshatch I test pattern.
9. FIGURE 9. Locate the other H-STAT control beneath the plastic cover on video board "C." Turn the H-STAT control until the color-shadowed vertical lines of the test pattern blend to solid white.
10. If the lines at the top or bottom of the test pattern still show color shadows, allow the monitor to warm up for 15 to 20 minutes, and go to step 11.

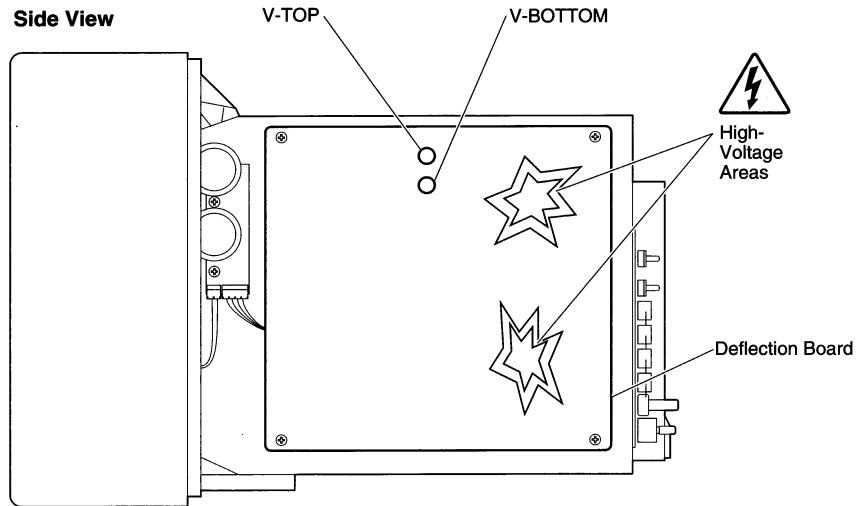


**Figure 9 H-STAT Control**

**▲ Warning**

**Follow the standard safety precautions and take care to avoid high-voltage areas on the solder side of the main board.**

11. FIGURE 10. If the horizontal lines at the top of the test pattern are out of adjustment, turn the V-TOP (RV518) control until the color-shadowed lines blend to solid white lines.
12. FIGURE 10. If the horizontal lines at the bottom of the monitor are out of adjustment, turn the V-BOTTOM (RV517) control until the color-shadowed lines blend to solid white lines.



**Figure 10 V-TOP and V-BOTTOM Controls**

### **Geometric Distortion Adjustment**

Perform the following geometric distortion adjustment only if attempts to adjust raster distortions with the external controls do not produce the desired results.

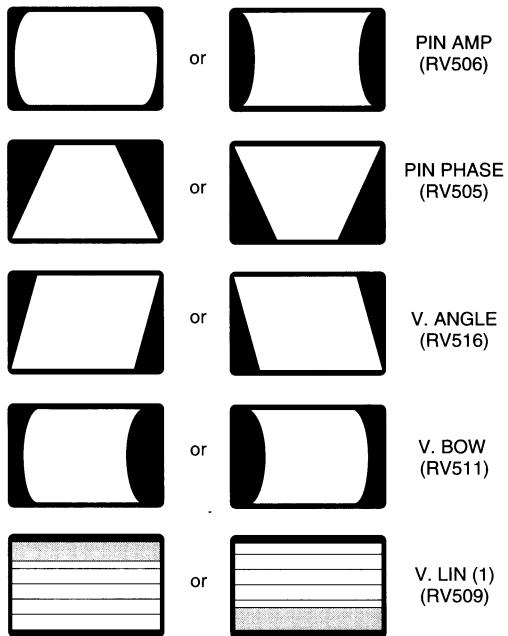
#### **Materials Required**

Eight-inch (or longer) plastic adjustment tool

Appropriate diagnostic (See the Monitor Diagnostics table in the General Monitor Information chapter.)

**▲ Warning** When performing the Geometric Distortion Adjustment, avoid the high-voltage areas on the solder side of deflection board "D" outlined in FIGURE 10.

1. Remove the monitor cover and the EMI shield. Connect the video cable to the monitor and switch on the monitor.
2. Display the crosshatch I or II test pattern.
3. Make sure the boxes on the top and bottom rows are the same size. Then, make sure the boxes on the left and right sides of the test pattern are the same size.



**Figure 11 Geometric Distortions**

4. FIGURE 11. If any of the test pattern boxes are not the same size, compare the test pattern display with the geometric distortions shown in FIGURE 11.

**▲ Warning**

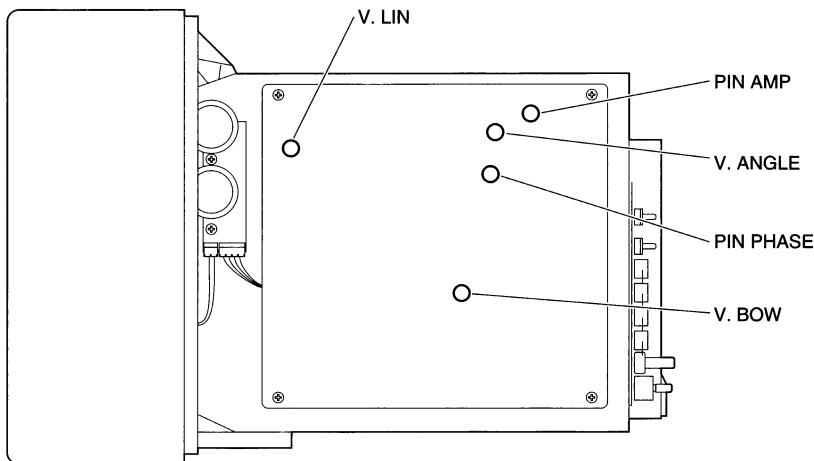
**There are very high voltages on the entire yoke assembly. To prevent electrical shock, avoid touching the yoke assembly, the anode wire, or any of the yoke wires when performing the geometric adjustments.**

5. FIGURE 12. Using the eight-inch plastic adjustment tool, carefully reach inside the monitor chassis and adjust the appropriate pot on deflection board "D."

---

6. If the display is so distorted that you are unable to tell which adjustment to make, perform the adjustments in the following sequence:
  - PIN AMP
  - PIN PHASE
  - V. ANGLE
  - V. BOW
  - Repeat V. ANGLE
  - Repeat PIN PHASE
7. If you are unable to correct the distortion, replace the deflection board "D."

**Side View**



**Figure 12 Geometric Distortion Adjustments**



# Macintosh Color Display



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## Illustrated Parts List

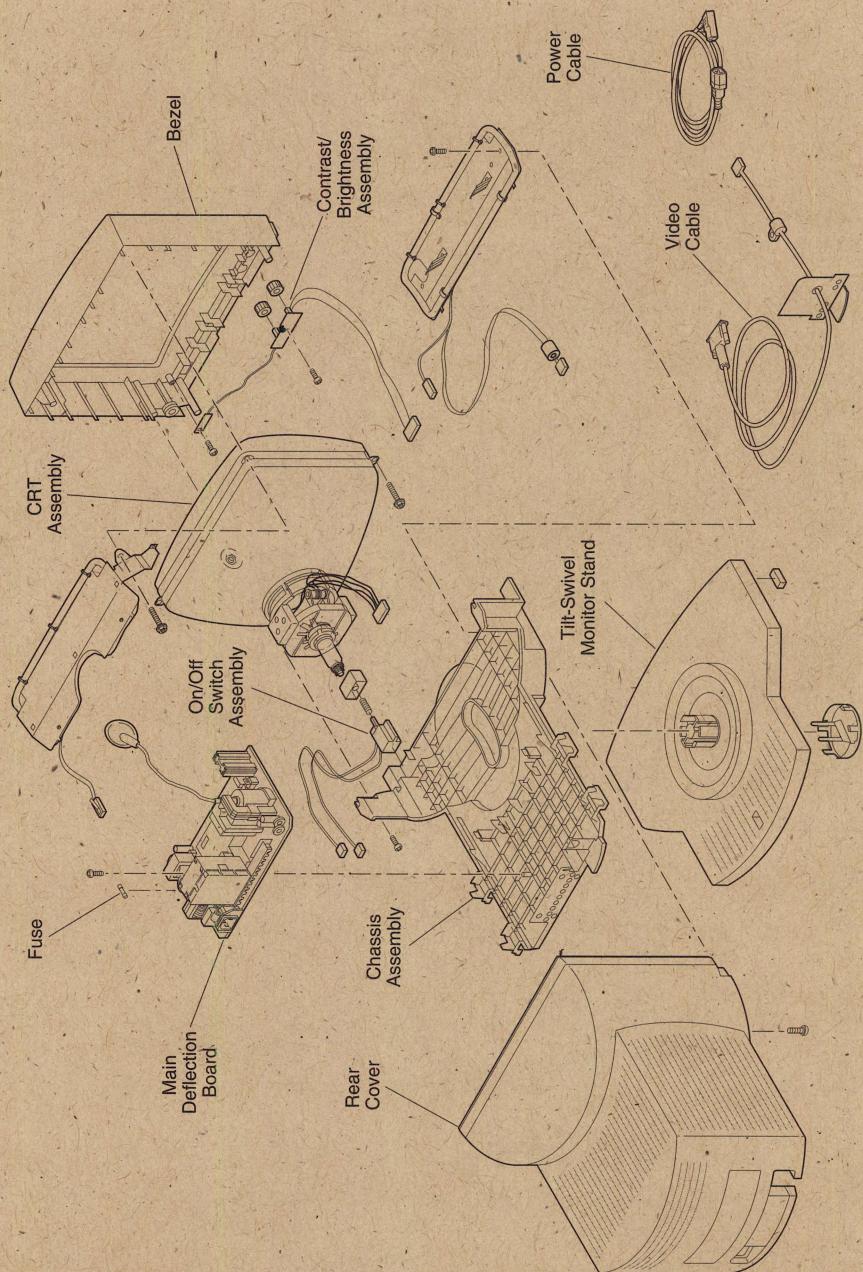


Figure 1 Macintosh Color Display Exploded View

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Cables	
Cable, external power, 110 V .....	590-0370
Cable, external power, 220 V .....	590-0423
Cable, video .....	922-0035
Case and stand parts	
Bezel (with contrast/brightness assembly) .....	922-0033
Chassis assembly .....	922-0032
Rear cover.....	922-0034
Screw/knob set.....	076-1020
Tilt-swivel monitor stand .....	922-0037
CRT assemblies	
CRT assembly .....	661-1666
CRT assembly, North AS/AG .....	661-1668
CRT assembly, reversed polarity .....	661-1667
Fuse, 3.15 A .....	740-0806
Main board.....	661-1650
Other assemblies	
Contrast/brightness assembly (includes LED).....	922-0036
On/off switch assembly .....	922-0031

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## Troubleshooting

---

### Symptom/Cure Chart

Use the following chart as a troubleshooting guide. If the first corrective action does not solve the problem, reinstall the original module before proceeding to the next step. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement. For information on environmental distortions, see the General Monitor Information chapter.

No Raster	Solutions
No raster, LED off	<ol style="list-style-type: none"><li>1. Check the power cable and the power switch.</li><li>2. Verify that all connectors are secure on the main board.</li><li>3. Check fuse; replace if blown. If it blows again, go to next step.</li><li>4. Replace the main board.</li></ol>
No raster, LED on, CRT filament on	<ol style="list-style-type: none"><li>1. Adjust the contrast and brightness controls.</li><li>2. Verify that the video card (in the CPU) is working properly.</li><li>3. Verify that all connectors are secure on the main board.</li><li>4. Perform the video adjustments.</li><li>5. Replace the main board.</li><li>6. Replace the CRT.</li></ol>

### Geometric Problems<sup>1</sup> Solutions

Raster size too short/tall, narrow/wide	<ol style="list-style-type: none"><li>1. Adjust the vertical or horizontal size controls (as appropriate).</li><li>2. Replace the main board.</li></ol>
Raster not centered	<ol style="list-style-type: none"><li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li><li>2. Adjust the horizontal or vertical center controls.</li><li>3. Replace the main board.</li></ol>
Horizontal linearity bad (size of text/ graphics differs at sides of screen)	<ul style="list-style-type: none"><li>– Replace the main board.</li></ul>
Vertical linearity bad (size of text/ graphics differs at top/bottom of screen)	<ul style="list-style-type: none"><li>– Replace the main board.</li></ul>
Raster tilt or shift	<ol style="list-style-type: none"><li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li><li>2. Perform the appropriate geometric adjustments.</li><li>3. If the raster is tilted, perform the yoke adjustments.</li><li>4. Replace the main board.</li></ol>

---

<sup>1</sup> Remember, slight geometric distortion problems cannot be solved by replacing modules.

---

Abnormal/distorted raster: • barrel-shaped • corners not square • stretched or compressed at top of display • sides not perpendicular	<ol style="list-style-type: none"> <li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li> <li>2. Perform the appropriate geometric adjustments.</li> <li>3. Replace the main board.</li> <li>4. Replace the CRT (only in very rare instances).</li> </ol>
<b>Synchronization Problems</b>	<b>Solutions</b>
Picture breaks in diagonal lines	<ol style="list-style-type: none"> <li>1. Connect another monitor to the computer and switch power on to verify that a video signal is coming from the computer.</li> <li>2. Replace the main board.</li> </ol>
Picture rolls vertically	<ol style="list-style-type: none"> <li>1. Verify that the video card (in the CPU) is working properly.</li> <li>2. Replace the main board.</li> </ol>
Picture breaks and rolls horizontally	<ol style="list-style-type: none"> <li>1. Verify that the video card (in the CPU) is working properly.</li> <li>2. Replace the main board.</li> </ol>
Black raster with single vertical or horizontal line appears	<ol style="list-style-type: none"> <li>1. Replace the main board.</li> <li>2. Replace the CRT.</li> </ol>
<b>Video/Color Problems</b>	<b>Solutions</b>
Predominant color tint or color cannot be adjusted	<ol style="list-style-type: none"> <li>1. Verify that the video card (in the CPU) is working properly.</li> <li>2. Perform the video adjustments.</li> <li>3. Replace the main board.</li> <li>4. Replace the CRT if the red, green, or blue cannot be turned off using the appropriate controls.</li> </ol>
Picture too dark, too bright, or washed out	<ol style="list-style-type: none"> <li>1. Adjust the contrast and brightness controls.</li> <li>2. Verify that the video card (in the CPU) is working properly.</li> <li>3. Perform the video adjustments.</li> <li>4. Replace the main board.</li> <li>5. Replace the CRT.</li> </ol>
Out of focus	<ol style="list-style-type: none"> <li>1. Perform the focus adjustment.</li> <li>2. Replace the main board.</li> <li>3. Replace the CRT only if bad focus remains on one part of the display despite adjustment of focus controls to their limits.</li> </ol>
Out of convergence (color bleeding out from text or lines)	<ol style="list-style-type: none"> <li>1. Verify that the video card (in the CPU) is working properly.</li> <li>2. Perform the convergence adjustment.</li> <li>3. Replace the main board.</li> <li>4. Replace the CRT.</li> </ol>

---

Misc. Problems	Solutions
Intermittent shutdown	<ul style="list-style-type: none"><li>– Replace the main board.</li></ul>
Picture jitters or flashes	<ol style="list-style-type: none"><li>1. Verify that all ground cables are secure.</li><li>2. Verify that adjacent computer equipment is properly grounded. Move electrical devices away from the monitor. Temporarily shut off all fluorescent lights in the area.<sup>2</sup></li><li>3. Replace the main board.</li></ol>
Flashing or wavy screen	<ul style="list-style-type: none"><li>– Replace the main board.</li></ul>
Black screen spots (burnt phosphor)	<ul style="list-style-type: none"><li>– Replace the CRT.</li></ul>
Monitor emits high-pitched noise	<ul style="list-style-type: none"><li>– Replace the main board.</li></ul>
Does not degauss	<ul style="list-style-type: none"><li>– Replace the main board.</li></ul>
Erratic or no communication with ADB device	<ul style="list-style-type: none"><li>– Replace the keyboard cable, keyboard, mouse, or other ADB device.</li></ul>

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<sup>2</sup> External electrical interference problems cannot be solved by monitor adjustments or replacement of modules.

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## Safety Instructions

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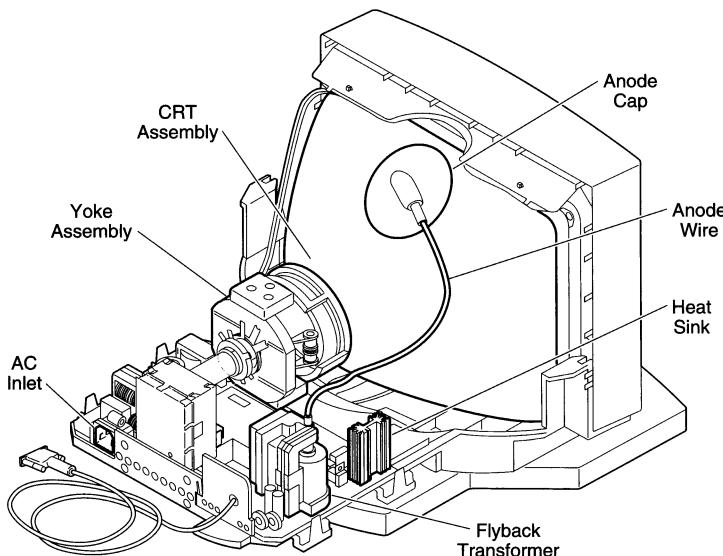
**▲ Warning** **The Macintosh Color Display contains a high-vacuum picture tube and operates at very high voltages. To prevent serious injury, review the CRT Safety rules in the General Monitor Information chapter.**

---

- Keep one hand behind your back at all times, and grasp the handle of the insulated alignment tool with your other hand.
- Use a mirror for viewing adjustment results.
- Perform only those adjustments that are absolutely necessary. Do not attempt to make any adjustments other than the ones explained in this section, and do those with extreme caution.

**▲ Warning** **Serious injury could result if, with the power on, you touch any of the high-voltage areas shown in Figure 2.**

---



**Figure 2 High-Voltage Areas**

---

## Adjustments

---

### Geometric Adjustments

#### Materials Required

Short hex-head plastic adjustment tool

Mirror

Flexible metric ruler

Appropriate diagnostic (See the Monitor Diagnostics table in the General Monitor Information chapter.)

#### Horizontal Center

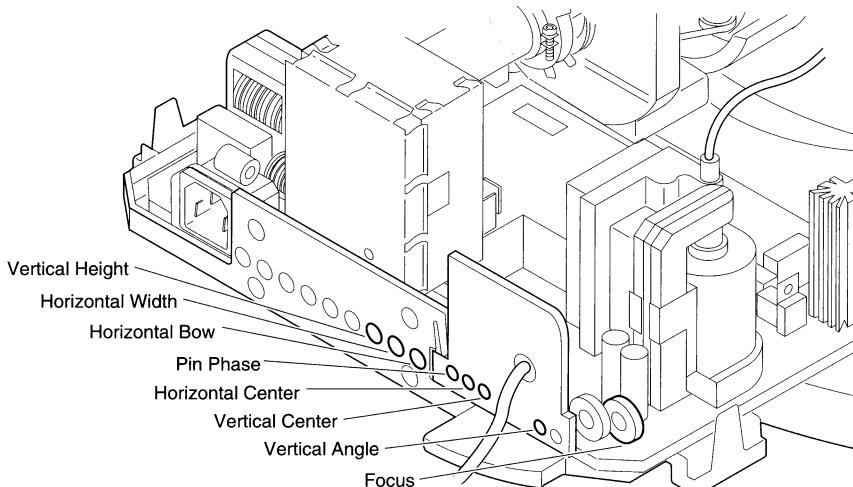
1. Boot the diagnostic and display the all-white test pattern.
2. FIGURE 3. Using the hex-head adjustment tool, turn the Horizontal Center control until the raster is centered (left to right) in the bezel.

#### Horizontal Size

- FIGURE 3. Using the adjustment tool, turn the Horizontal Width control until the raster is 9 1/4 inches ( $\pm$  1/8 inch) or 235 mm ( $\pm$  2 mm) wide.

#### Vertical Center

- FIGURE 3. Using the adjustment tool, turn the Vertical Center control until the raster is centered (top to bottom) in the bezel.



**Figure 3 Geometric Adjustment Controls**

---

## **Vertical Size**

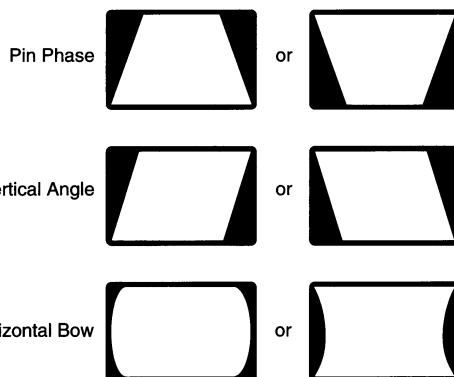
- FIGURE 3. Using the adjustment tool, adjust the Vertical Height control until the raster height is 7 inches ( $\pm 1/8$  inch) or 176 mm ( $\pm 2$  mm). If the raster is now off-center, repeat the vertical center adjustment.

## **Focus**

1. Display the focus test pattern.
2. FIGURE 3. Adjust the Focus control until the focus test pattern is as clear as possible.

## **Geometric Distortion**

1. Display the crosshatch test pattern.
2. FIGURE 4. Compare your raster distortion with the common raster distortions shown below, then adjust the suggested control.
  - a. Pin Phase
  - b. Vertical Angle
  - c. Horizontal Bow
  - d. Repeat Vertical Angle
  - e. Repeat Pin Phase
3. FIGURE 3. If the display is so distorted that you can't tell which adjustment to make, adjust the following controls:



**Figure 4 Geometric Raster Distortion**

---

## **Video Adjustments**

Perform the cutoff and white balance adjustments after the monitor has been on for at least 10 minutes. Perform the cutoff adjustment prior to adjusting the white balance and whenever you replace the CRT assembly or the main board.

### **Materials Required**

Short hex-head plastic adjustment tool

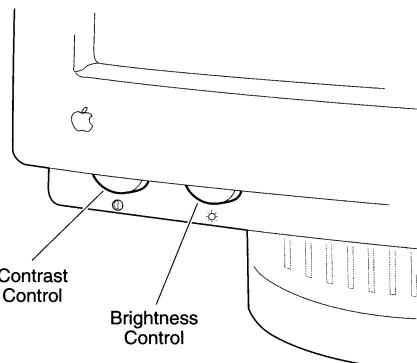
Mirror

Light meter (Sekonic Multi-Lumi, model L-248)

Appropriate diagnostic (See the Monitor Diagnostics table in the General Monitor Information chapter.)

### **Cutoff**

1. Boot the diagnostic and display the gray bars test pattern.
2. FIGURE 5. Set the contrast control to maximum and the brightness control to the center (detent) position.
3. FIGURE 6. Using the hex-head adjustment tool, adjust the Red, Green, and Blue Background controls to the full counterclockwise positions.
4. FIGURE 6. Set the Green Drive and Blue Drive controls clockwise to the 3/4 position (turn the controls full clockwise, then back 1/4 turn).
5. FIGURE 6. Set the Sub-Contrast control to the full clockwise position.
6. FIGURE 6. Using the adjustment tool, adjust G2 until the first bar is completely black and the second bar is barely visible.
7. FIGURE 5. Set the Sub-Contrast control to center position.

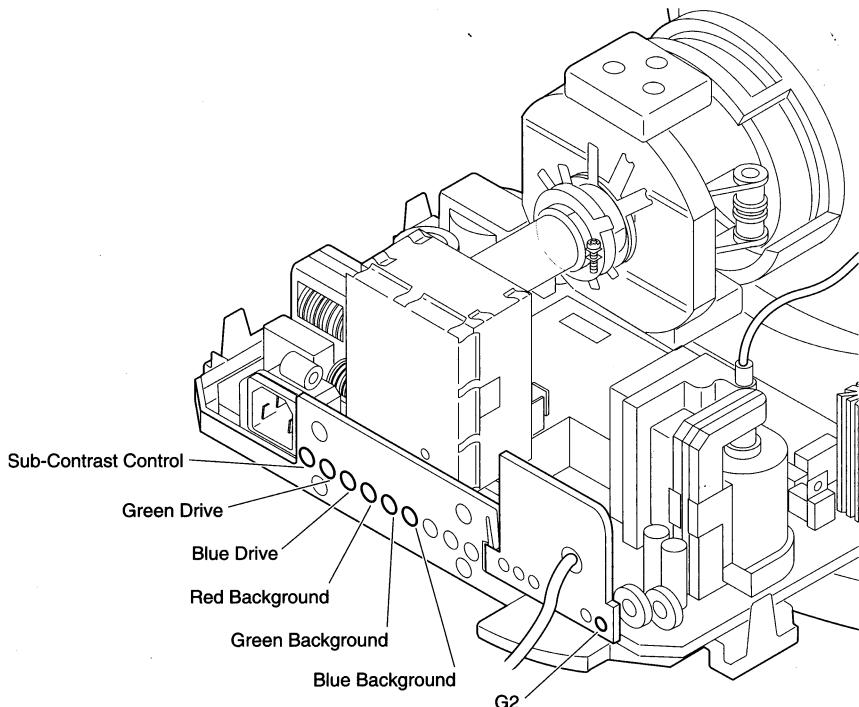


**Figure 5 Contrast and Brightness Controls**

---

## White Balance

1. Display the gray bars test pattern.
2. FIGURE 5. Set the contrast control to maximum and the brightness control to the center (detent) position.
3. FIGURE 6. Noting the predominant color, use the hex-head adjustment tool and alternately adjust the Red, Green, and Blue Background controls until there is no predominant color in the four darkest bars. The darkest bar must be completely black. If necessary, adjust the Blue and Green Drive controls until there is no predominant color in the four brightest bars.
4. FIGURE 6. Check the four darkest bars, and if necessary, adjust the Red, Green, and Blue Background controls until there is no predominant color.
5. Display the all-white test pattern.
6. FIGURE 6. Using a light meter, adjust the Sub-Contrast control until the light meter measures in the middle of the 10 scale.



**Figure 6 Video Adjustment Controls**

---

## Convergence Adjustments

1. Boot the diagnostic and display the crosshatch test pattern.
2. FIGURE 7. Using the hex-head adjustment tool, adjust the Convergence control on the CRT video board for best overall convergence.
3. FIGURE 7. Using the adjustment tool, adjust the N/S Amp control on the CRT video board for best convergence of horizontal lines at the top and bottom of the screen.
4. FIGURE 7. Adjust the Lower Convergence control on the CRT video board for best convergence of vertical lines at the bottom of the screen.
5. FIGURE 7. Adjust the Upper Convergence control on the CRT video board for best convergence of vertical lines at the top of the screen.

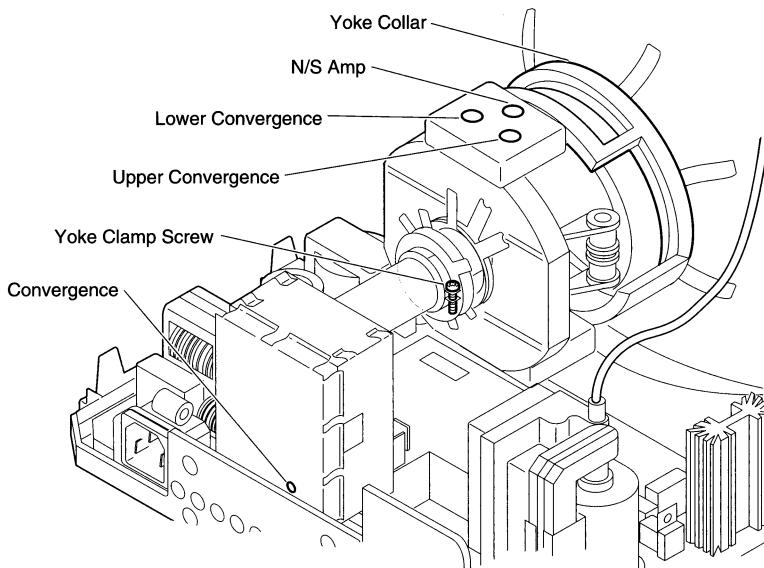


Figure 7 Convergence and Yoke Adjustments

---

## **Yoke Adjustment**

If you replace the CRT, you will probably need to adjust the yoke.

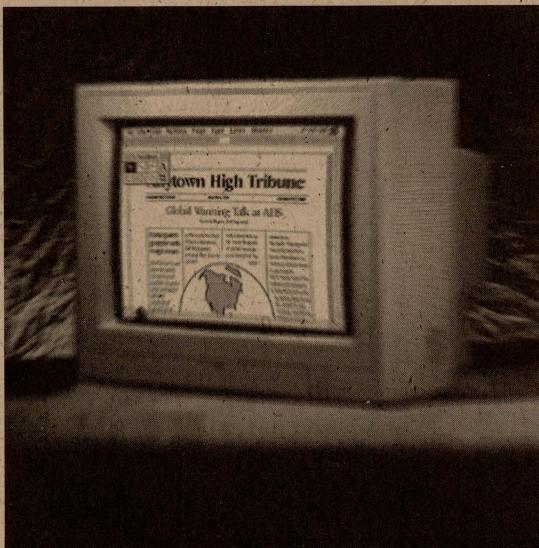
### **Materials Required**

Insulated Phillips screwdriver  
Mirror

1. FIGURE 7. Using the insulated screwdriver, loosen the yoke clamp screw with two or three turns.
2. Switch on the computer.
3. FIGURE 7. With one hand, grasp the plastic yoke collar, and rotate the yoke collar until the top and bottom edges of the picture are parallel with the top and bottom of the bezel.
4. Switch off and unplug the computer.
5. Discharge the CRT.
6. FIGURE 7. Hold the collar in position and carefully tighten the yoke clamp screw so that the collar cannot slip. Do not overtighten the screw.
7. Replace the cover and switch on the computer. Make sure the top and bottom edges of the picture are parallel with the top and bottom of the bezel.



# **Apple Performa Display and Performa Display Plus**

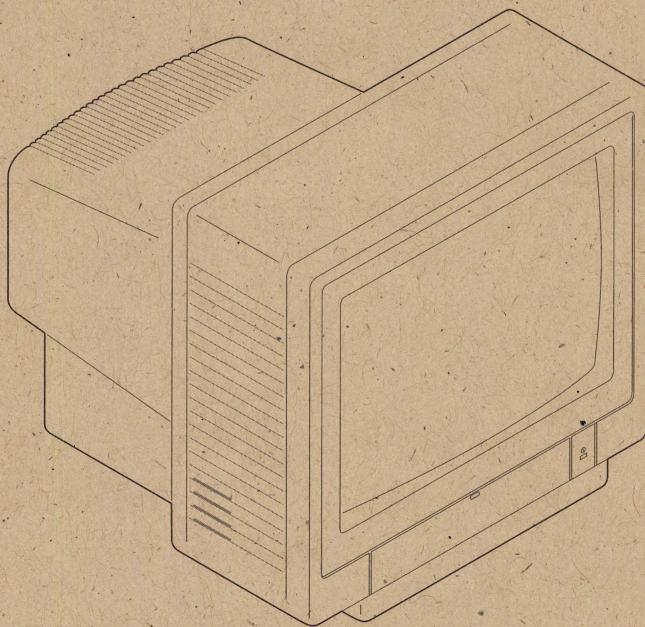


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## Illustrated Parts List

### Apple Performa Display and Performa Display Plus

Performa Plus .29 (whole-unit-exchange module) .....	661-1669
Performa .39 (whole-unit-exchange module).....	661-1670



**Figure 1 Apple Performa Display and Performa Display Plus**

---

## Adjustments

---

### User Adjustments

FIGURE 2. Always adjust the contrast and brightness controls before attempting further adjustments or repair.

---

### Geometric Adjustments

#### Materials Required

Small flat-blade screwdriver  
Mirror  
Flexible metric ruler

**▲ Warning** **This monitor contains high voltage and a high-vacuum picture tube. To prevent serious personal injury or equipment damage, review the CRT safety and discharge instructions in the General Monitor Information chapter.**

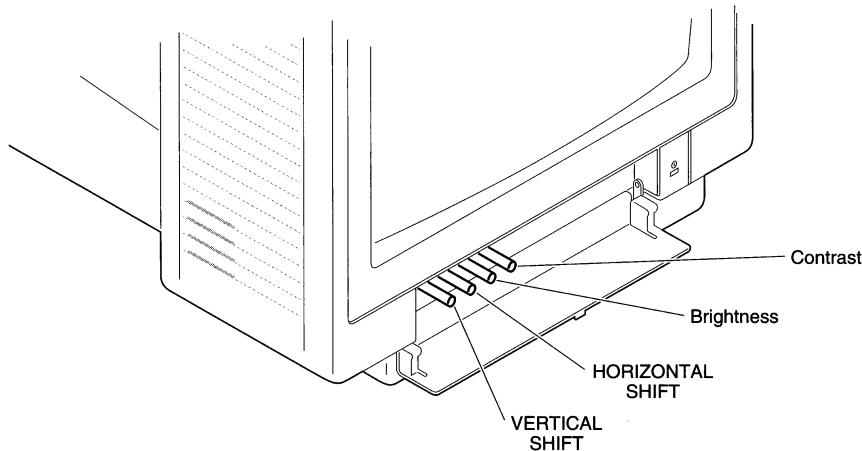
---

#### Horizontal Center

- FIGURE 2. Turn the HORIZONTAL SHIFT control until the raster is centered (left to right) in the bezel.

#### Vertical Center

- FIGURE 2. Turn the VERTICAL SHIFT control until the raster is centered (top to bottom) in the bezel.



**Figure 2 Centering Controls**

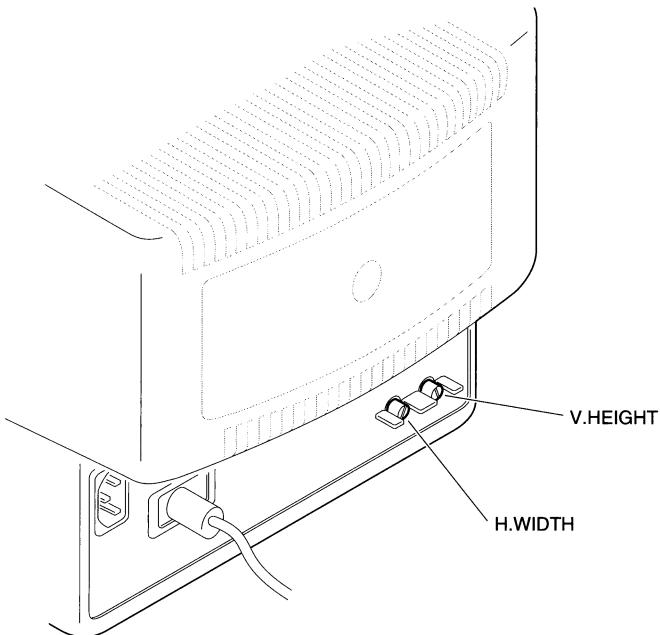
---

## **Horizontal Size**

- FIGURE 3. Using the screwdriver, turn the H.WIDTH control until the raster is 240 mm ( $\pm$  2 mm) or 9 1/2 inches ( $\pm$  1/8 inch) wide.

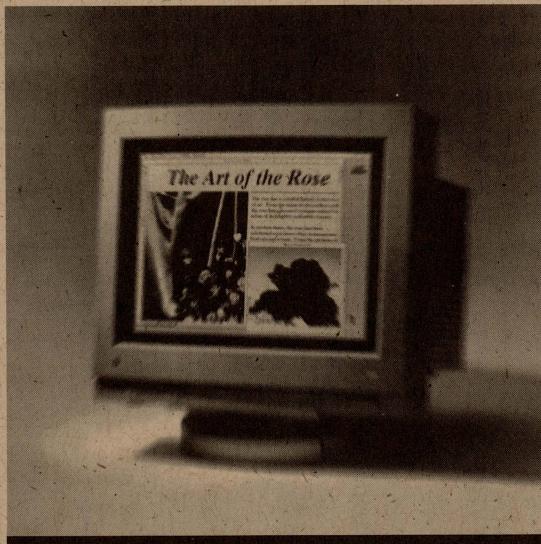
## **Vertical Size**

- FIGURE 3. Using the screwdriver, adjust the V.HEIGHT control until the raster height is 180 mm ( $\pm$  2 mm) or 7 1/8 inches ( $\pm$  1/8 inch).



**Figure 3 Size Controls**

# Macintosh 16-Inch Color Display



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## Illustrated Parts List

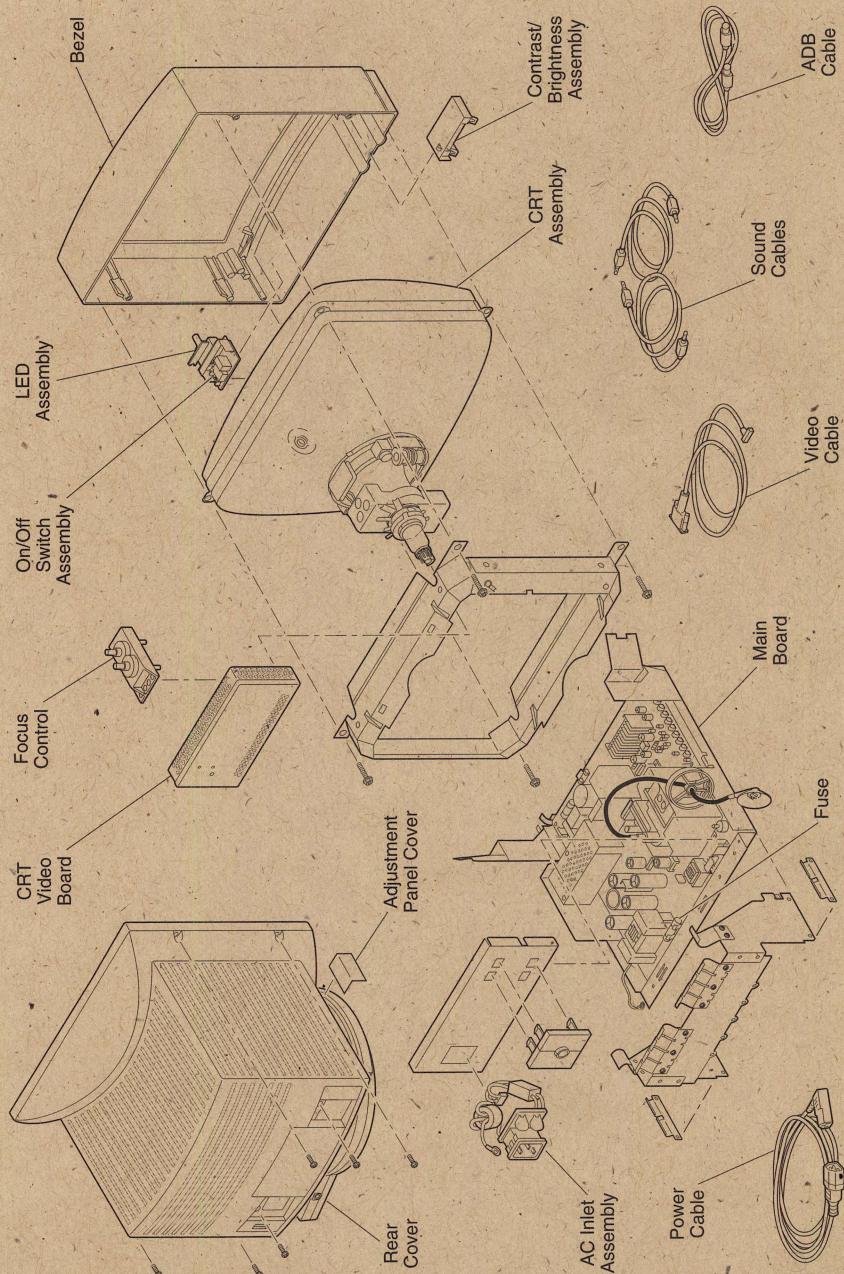
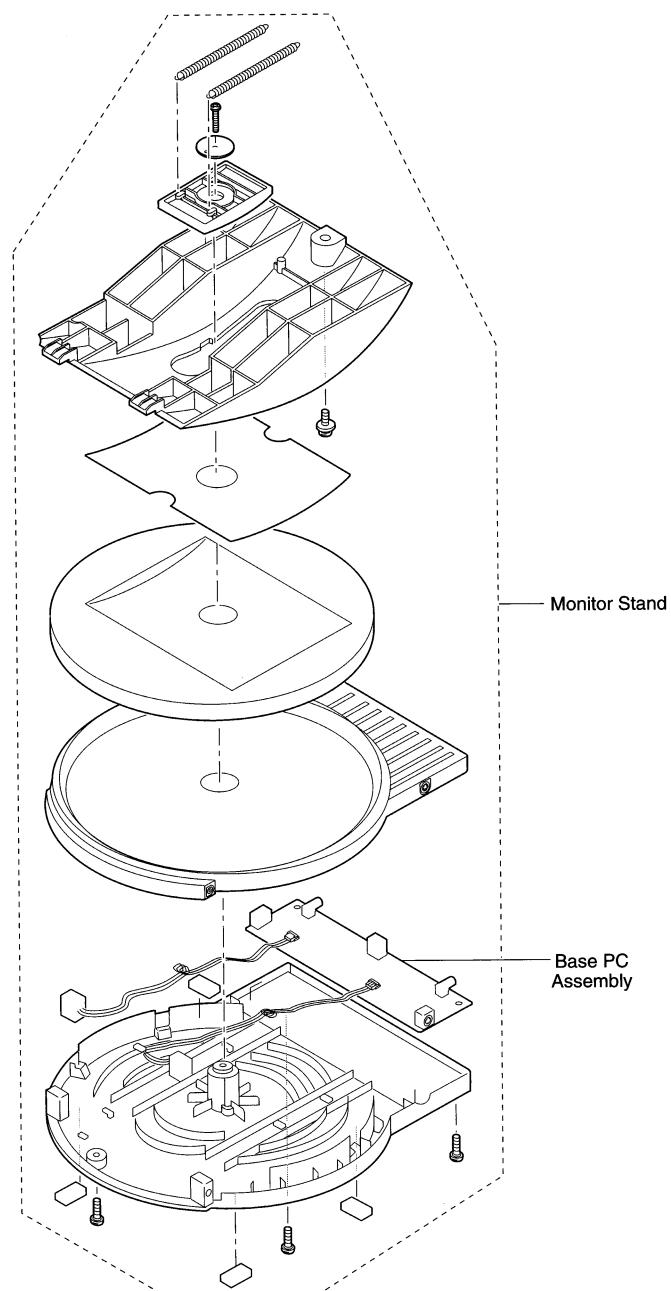


Figure 1 Macintosh 16-Inch Color Display Exploded View



**Figure 2 Macintosh 16-Inch Color Display Monitor Stand Exploded View**

---

## Cables

Cable accessory kit (not shown) ..... 076-1018

Cable, ADB (CPU to stand) ..... 590-4501

Cable, external power, 110 V ..... 590-0373

Cable, external power, 220 V ..... 590-0423

Cable, LED assembly ..... 982-0125

Cable, sound in ..... 590-4512

Cable, sound out ..... 590-4513

Cable, video (CPU to monitor) ..... 590-0734

## Case and stand parts

Adjustment panel cover ..... 949-0385

Base PC assembly ..... 981-0029

Bezel, rev. B (replaces 949-0376) ..... 949-0394

Rear cover ..... 949-0375

Screw/knob set ..... 076-0565

Tilt-swivel monitor stand ..... 949-0374

## CRT assemblies

CRT assembly ..... 076-0563

CRT assembly, reversed polarity ..... 076-0564

Focus H.Stat control ..... 982-0139

Fuse, 250 V, 3.15 A ..... 740-0108

## Other component assemblies

AC inlet assembly ..... 982-0126

Contrast/brightness assembly ..... 982-0127

On/off switch assembly ..... 982-0128

## Printed circuit boards

CRT video board ..... 661-1635

Main board, rev. B (replaces 661-1634) ..... 661-1671

---

## Troubleshooting

---

### Symptom/Cure Chart

Use the following chart as a troubleshooting guide. If the first corrective action does not solve the problem, reinstall the original module before proceeding to the next step. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement. For information on environmental distortions, see the General Monitor Information chapter.

No Raster	Solutions
No raster, LED off	<ol style="list-style-type: none"><li>1. Check the power cable and the power switch.</li><li>2. Verify that all connectors are secure on the main board.</li><li>3. Check fuse; replace if blown. If it blows again, go to next step.</li><li>4. Replace the main board.</li></ol>
No raster, LED on, no CRT filament, high voltage OK	<ol style="list-style-type: none"><li>1. Check the connection at D-5 on the main board.</li><li>2. Check the continuity of the D-5 cable (from "H" pins on CRT socket). If bad, replace the CRT video board.</li><li>3. Replace the main board.</li></ol>
No raster, LED on, CRT filament on	<ol style="list-style-type: none"><li>1. Adjust the contrast and brightness user controls.</li><li>2. Verify that the video card (in the CPU) is working properly.</li><li>3. Ensure that all connectors are secure on the main board and the CRT video board.</li><li>4. Perform the video adjustments.</li><li>5. Replace the main board.</li><li>6. Replace the CRT video board.</li><li>7. Replace the CRT.</li></ol>
Geometry Problems <sup>1</sup>	Solutions
Raster size too short/tall, narrow/wide	<ol style="list-style-type: none"><li>1. Adjust the vertical or horizontal size controls (as appropriate) on the main board.</li><li>2. Replace the main board.</li></ol>
Raster not centered	<ol style="list-style-type: none"><li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li><li>2. Adjust the horizontal shift or vertical center controls on the main board.</li><li>3. Replace the main board.</li></ol>
Horizontal linearity bad (size of text/graphics differs at sides of screen)	<ul style="list-style-type: none"><li>– Replace the main board.</li></ul>

---

<sup>1</sup> Remember, slight geometric distortion problems cannot be solved by replacing modules.

---

Vertical linearity bad (size of text/graphics differs at top/bottom of screen)	<ol style="list-style-type: none"> <li>1. Adjust the vertical linearity control on the main board.</li> <li>2. Replace the main board.</li> </ol>
Entire raster is tilted	<ol style="list-style-type: none"> <li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li> <li>2. Adjust the yoke assembly as follows: <ul style="list-style-type: none"> <li>a. Switch off the monitor power and remove the rear cover.</li> <li>b. Loosen the screw closest to the monitor screen on the neck of the CRT.</li> <li>c. Twist the yoke assembly as appropriate.</li> <li>d. Retighten the screw on the CRT neck. (Be careful not to overtighten the screw; overtightening could break the CRT neck.)</li> <li>e. Switch on the monitor and check the display. Repeat these steps if necessary.</li> </ul> </li> <li>3. Replace the main board.</li> </ol>
Abnormal/distorted raster: <ul style="list-style-type: none"> <li>• barrel-shaped</li> <li>• corners not square</li> <li>• stretched or compressed at top of display</li> <li>• sides not perpendicular</li> </ul>	<ol style="list-style-type: none"> <li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li> <li>2. Perform the appropriate geometric adjustments.</li> <li>3. Replace the main board.</li> <li>4. Replace the CRT.</li> </ol>
<b>Synchronization Problems</b>	<b>Solutions</b>
Picture breaks in diagonal lines	<ol style="list-style-type: none"> <li>1. Connect another monitor to the computer and switch power on to verify that a video signal is coming from the computer.</li> <li>2. Replace the main board.</li> </ol>
Picture rolls vertically	<ol style="list-style-type: none"> <li>1. Verify that the video card (in the CPU) is working properly.</li> <li>2. Replace the main board.</li> <li>3. Replace the CRT video board.</li> </ol>
Picture breaks and rolls horizontally	<ol style="list-style-type: none"> <li>1. Verify that the video card (in the CPU) is working properly.</li> <li>2. Replace the main board.</li> </ol>
Black raster with single vertical or horizontal line appears	<ol style="list-style-type: none"> <li>1. Verify that the CRT video board is tight on the yoke connector.</li> <li>2. Replace the main board.</li> <li>3. Replace the CRT.</li> </ol>

---

<b>Video Problems</b>	<b>Solution</b>
Predominant color tint, or color cannot be adjusted	<ol style="list-style-type: none"> <li>1. Verify that the video card (in the CPU) is working properly.</li> <li>2. Perform the video adjustments.</li> <li>3. Replace the CRT video board.</li> <li>4. Replace the CRT if the red, green, or blue cannot be turned off using the appropriate controls.</li> </ol>
Picture too dark or too bright	<ol style="list-style-type: none"> <li>1. Adjust the brightness and contrast controls.</li> <li>2. Verify that the video card (in the CPU) is working properly.</li> <li>3. Perform the video adjustments.</li> <li>4. Replace the CRT video board.</li> <li>5. Replace the main board.</li> <li>6. Replace the CRT.</li> </ol>
Out of focus	<ol style="list-style-type: none"> <li>1. Perform the focus adjustment.</li> <li>2. Replace the main board.</li> <li>3. Replace the focus control.</li> <li>4. Replace the CRT only if bad focus remains on one part of the display despite adjustment of focus controls to their limits.</li> </ol>
Out of convergence (color bleeding out from text or lines)	<ol style="list-style-type: none"> <li>1. Perform the convergence adjustments.</li> <li>2. Replace the CRT.</li> </ol>
<b>Misc. Problems</b>	<b>Solution</b>
Intermittent shutdown	<ul style="list-style-type: none"> <li>– Replace the main board.</li> </ul>
Picture jitters or flashes	<ol style="list-style-type: none"> <li>1. Verify that all ground cables are secure.</li> <li>2. Verify that adjacent computer equipment is properly grounded. Move electrical devices away from the monitor. Temporarily shut off all fluorescent lights in the area.<sup>2</sup></li> <li>3. Replace the main board.</li> </ol>
Flashing or wavy screen	<ul style="list-style-type: none"> <li>– Replace the main board.</li> </ul>
Black screen spots (burnt phosphor)	<ul style="list-style-type: none"> <li>– Replace the CRT.</li> </ul>
Monitor emits high-pitched noise	<ul style="list-style-type: none"> <li>– Replace the main board.</li> </ul>
Does not degauss	<ul style="list-style-type: none"> <li>– Replace the main board.</li> </ul>
Erratic or no communication with ADB device	<ol style="list-style-type: none"> <li>1. Replace the keyboard cable, keyboard, mouse, or other ADB device.</li> <li>2. Replace the ADB cable in the monitor stand.</li> </ol>

---

<sup>2</sup> External electrical interference problems cannot be solved by monitor adjustments or replacement of modules.

---

## Safety Instructions

---

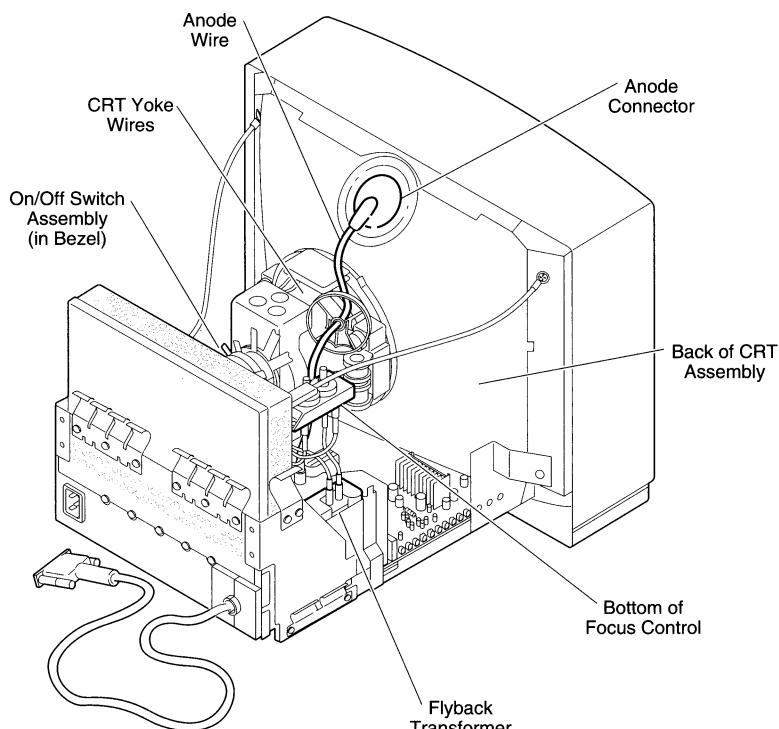
**▲ Warning** The Macintosh 16-Inch Color Display contains a high-vacuum picture tube and operates at very high voltages. To prevent serious injury, review the CRT Safety rules in the General Monitor Information chapter.

---

- Keep one hand behind your back at all times, and grasp the handle of the insulated alignment tool with your other hand.
- Use a mirror for viewing adjustment results.
- Perform only those adjustments that are absolutely necessary. Do not attempt to make any adjustments other than the ones explained in this section, and do those with extreme caution.

**▲ Warning** Serious injury could result if, with the power on, you touch any of the high-voltage areas shown in Figure 3.

---



**Figure 3 High-Voltage Areas**

### Geometric Adjustments

Before adjusting the 16-Inch Color Display, take the following precautions:

- Place the monitor on a level surface and make sure the body of the monitor is parallel to the level surface.
- Make sure the monitor faces magnetic east or west.
- Keep the monitor at least three feet from metal objects, such as steel filing cabinets. (Aluminum does not affect monitor adjustments.)

### Materials Required

Plastic adjustment tool or insulated screwdriver

Fine-tipped plastic adjustment tool (P/N 949-0386)

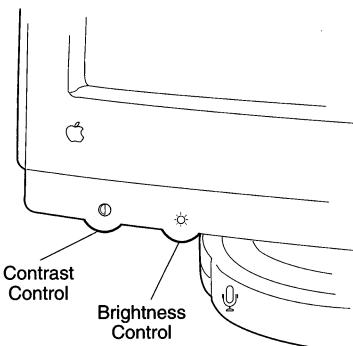
Flexible metric ruler

Light meter (Sekonic Multi-Lumi, model L-248)

Appropriate diagnostic (See the Monitor Diagnostics table in the General Monitor Information chapter.)

### Setup Steps

1. Switch off the monitor and place the monitor on a protective workbench pad.
2. Remove the rear cover.
3. Switch on the monitor and let it warm up for at least 15 minutes.
4. Swivel the monitor so that it faces magnetic east or west.
5. FIGURE 4. Set the brightness control to detent (midrange) and the contrast control to maximum (turn clockwise).



**Figure 4 Brightness and Contrast Controls**

---

## **Horizontal**

1. Display the crosshatch test pattern.
2. FIGURE 5. Turn the H.SIZE control until the width of the raster is 300 mm ( $\pm 3$  mm) or 11 7/8" ( $\pm 1/8$ ") wide.
3. FIGURE 5. Turn the H.SHIFT control until the raster is centered horizontally within the bezel.

**Note**

The KEY and KEY BAL controls affect each other. To get the left and right sides of the raster parallel, you may need to go back and forth between the KEY and KEY BAL controls.

4. FIGURE 5. Turn the KEY control until the left and right sides of the raster are parallel to each other.
5. FIGURE 5. Turn the KEY BAL control until the left and right sides of the raster are parallel to the bezel.

**Note**

The PIN AMP and PIN BAL controls affect each other. To get the left and right sides straight, you may need to go back and forth between these controls.

6. FIGURE 5. Turn the PIN AMP control until the left and right sides of the raster are as straight as possible.
7. FIGURE 5. Turn the PIN BAL control until the left and right sides of the raster as as straight as possible.

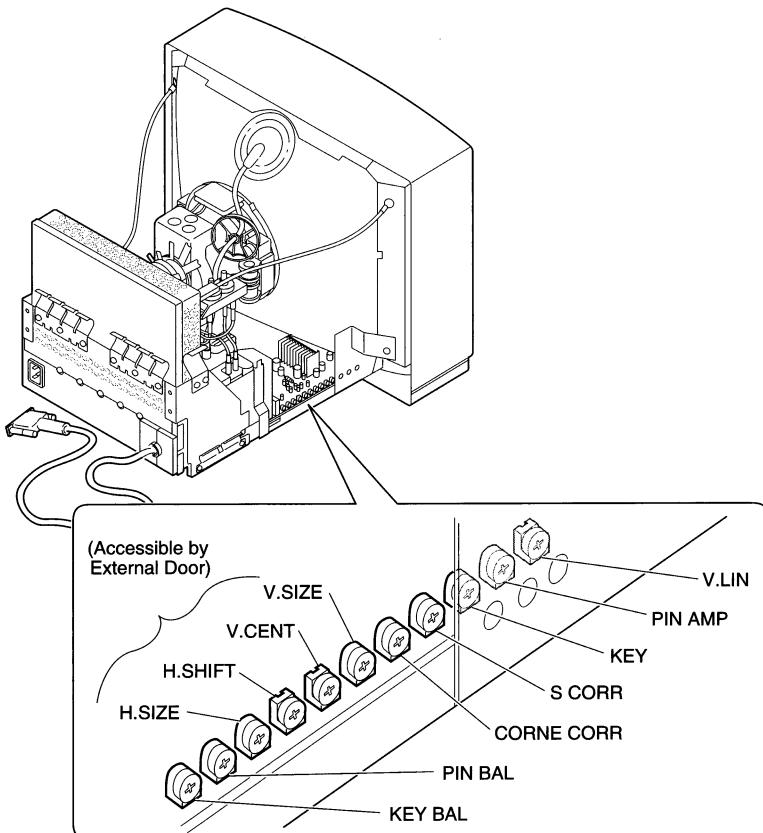
**Note**

The CORNE CORR and S CORR controls affect each other. To get the corners straight, you may need to go back and forth between the CORNE CORR and S CORR controls.

8. FIGURE 5. Turn the CORNE CORR control until the left and right sides of the raster are as straight as possible in the four corners of the screen.
9. FIGURE 5. Turn the S CORR control until the left and right sides of the raster are as straight as possible in the four corners of the screen.
10. Make sure the raster is still 300 mm ( $\pm 3$  mm) or 11 7/8" ( $\pm 1/8$ ") wide and that it is centered on the screen. If necessary, readjust the H.SIZE and H.SHIFT controls.

## **Vertical**

1. FIGURE 5. Turn the V.SIZE control until the raster is 225 mm ( $\pm 3$  mm) or 8 7/8" ( $\pm 1/8$ ") high.
2. FIGURE 5. Turn the V.CENT control until the raster is centered vertically within the bezel.
3. FIGURE 5. Turn the V.LIN control until the rectangles at the top and bottom of the raster are the same size.
4. Make sure the raster is still 225 mm or 8 7/8" high and that it is centered vertically within the bezel. If necessary, readjust the V.SIZE and V.CENT controls.



**Figure 5 Horizontal and Vertical Controls**

---

## **Focus**

1. Display the focus test pattern.
2. FIGURE 6. Turn the FOCUS control on the H.STAT focus control board for best overall focus.

## **Convergence**

### **Important**

Use the H.STAT control on the focus control board to make all convergence adjustments. Do not touch the yoke controls. With large-screen monitors it is not always possible to precisely align convergence at every point on the screen. Rather, try to attain the best possible overall alignment with the H.STAT control.

1. Display the crosshatch test pattern.
2. FIGURE 6. Turn the H.STAT control on the H.STAT focus control board until the red and blue vertical lines are aligned as precisely as possible.

---

## **Video Adjustments**

Always perform the video adjustments when you replace the CRT video board, the main board, or the CRT. Make sure you have performed necessary geometric adjustments before performing the video adjustments.

### **Materials Required**

Plastic adjustment tool or insulated screwdriver

Fine-tipped plastic adjustment tool (P/N 949-0386)

Flexible metric ruler

Light meter (Sekonic Multi-Lumi, model L-248)

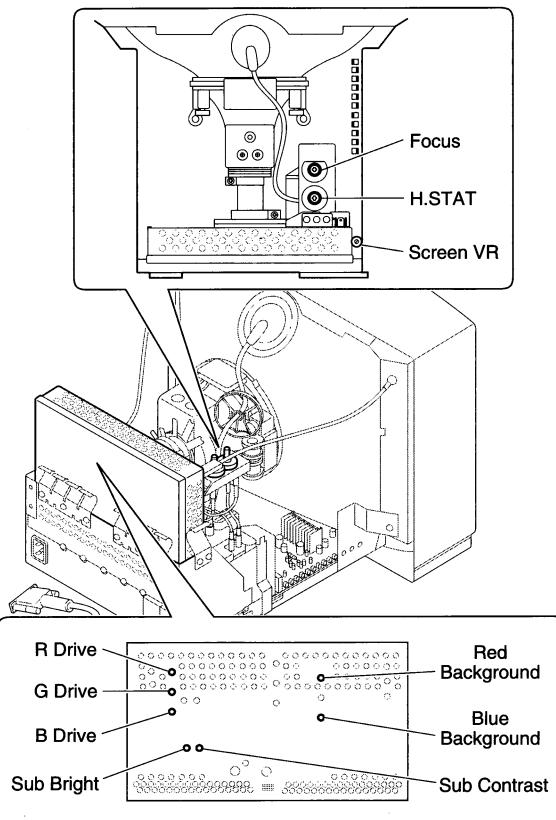
Appropriate diagnostic (See the Monitor Diagnostics table in the General Monitor Information chapter.)

## **Setup Steps**

1. Switch off the monitor and place the monitor on a protective workbench pad.
2. Remove the rear cover and the EMI shield.
3. Switch on the monitor and let it warm up for at least 15 minutes.
4. Swivel the monitor so that it faces magnetic east or west.
5. Set the brightness control to detent (midrange) and the contrast control to maximum (turn clockwise).

## Cutoff

1. Display the gray bars test pattern.
2. FIGURE 6. Using the fine-tipped insulated screwdriver, set the following controls on the CRT video board to the middle of their adjustment range:
  - Sub Bright
  - Sub Contrast
  - R, G, and B Drive
3. FIGURE 6. Using the fine-tipped insulated screwdriver, preset the Red and Blue Background controls to minimum (turn fully clockwise).



**Figure 6 Focus, Convergence, and Video Controls**

---

4. FIGURE 6. Adjust the Screen VR (RV508) control on the main board until the first (darkest) bar is completely black. If the screen does not display a predominant green tint, recheck the control settings in steps 2 and 3.
5. When the first bar is black and the screen has a green tint, proceed to the white balance adjustment.

## **White Balance**

**Important**

**Make sure the cutoff control is properly set before you perform the white balance adjustment. The life of the monitor may be severely reduced if the cutoff is not set correctly.**

1. FIGURE 6. Using the fine-tipped insulated screwdriver, slowly turn up (counterclockwise) the Blue Background control until the darkest six bars display a blue-green tint.
2. FIGURE 6. Slowly turn up (counterclockwise) the Red Background control until the darkest six bars display different shades of gray. No color tint should be visible in the gray bars.

**Note**

Alternately adjust the Blue and Red Background controls until there is no predominant color anywhere in the gray bars.

3. Display the all-white screen test pattern.
4. Set the light meter (Sekonic Multi-Lumi, model L-248) for the 2 to 10 range.
5. Using the light meter, measure the screen luminance at the center of the screen. Check that:
  - The light meter measures in the black band between the 9 and 10 scale
  - There is no predominant color in the gray bars
  - The first (darkest) bar is black

If these conditions are met, the white balance is set and you are finished. If the conditions are not met, go to the next step.

6. Find the conditions in the table below that match the customer's video display and perform the corrective steps.

---

## **Video Adjustment Problems and Corrective Steps**

<b>Display Conditions</b>	<b>Corrective Steps</b>
<ul style="list-style-type: none"><li>• Display shows no predominant color</li><li>• Screen luminance is too high</li><li>• First bar is not black</li></ul>	<ul style="list-style-type: none"><li>– Adjust the Sub Bright control slightly until the first bar is completely black.</li></ul>
<ul style="list-style-type: none"><li>• Display shows no predominant color</li><li>• Screen luminance is too high</li><li>• First bar is completely black</li></ul>	<ol style="list-style-type: none"><li>1. Alternately turn the R, G, and B Drive controls counterclockwise to reduce screen luminance, yet retain even shades of gray in the six brightest bars.</li><li>2. If the six darkest bars now have a color tint, readjust the Red and Blue Background controls.</li></ol>
<ul style="list-style-type: none"><li>• Display shows no predominant color</li><li>• Screen luminance is too low</li></ul>	<ol style="list-style-type: none"><li>1. Alternately turn the R, G, and B Drive controls clockwise to increase screen luminance, yet retain even shades of gray in the six brightest bars.</li><li>2. If the six darkest bars now have a color tint, readjust the Red and Blue Background controls.</li></ol>
<ul style="list-style-type: none"><li>• The six brightest bars have a predominant color tint</li></ul>	<ol style="list-style-type: none"><li>1. Alternately adjust the R, G, and B Drive controls until there is no predominant color.</li><li>2. Select the all-white screen test pattern and recheck the screen luminance. If necessary, adjust the Sub Bright control until the light meter reads in the black band between the 9 and 10 scales.</li></ol>



# Macintosh 21-Inch Color Display



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## Illustrated Parts List

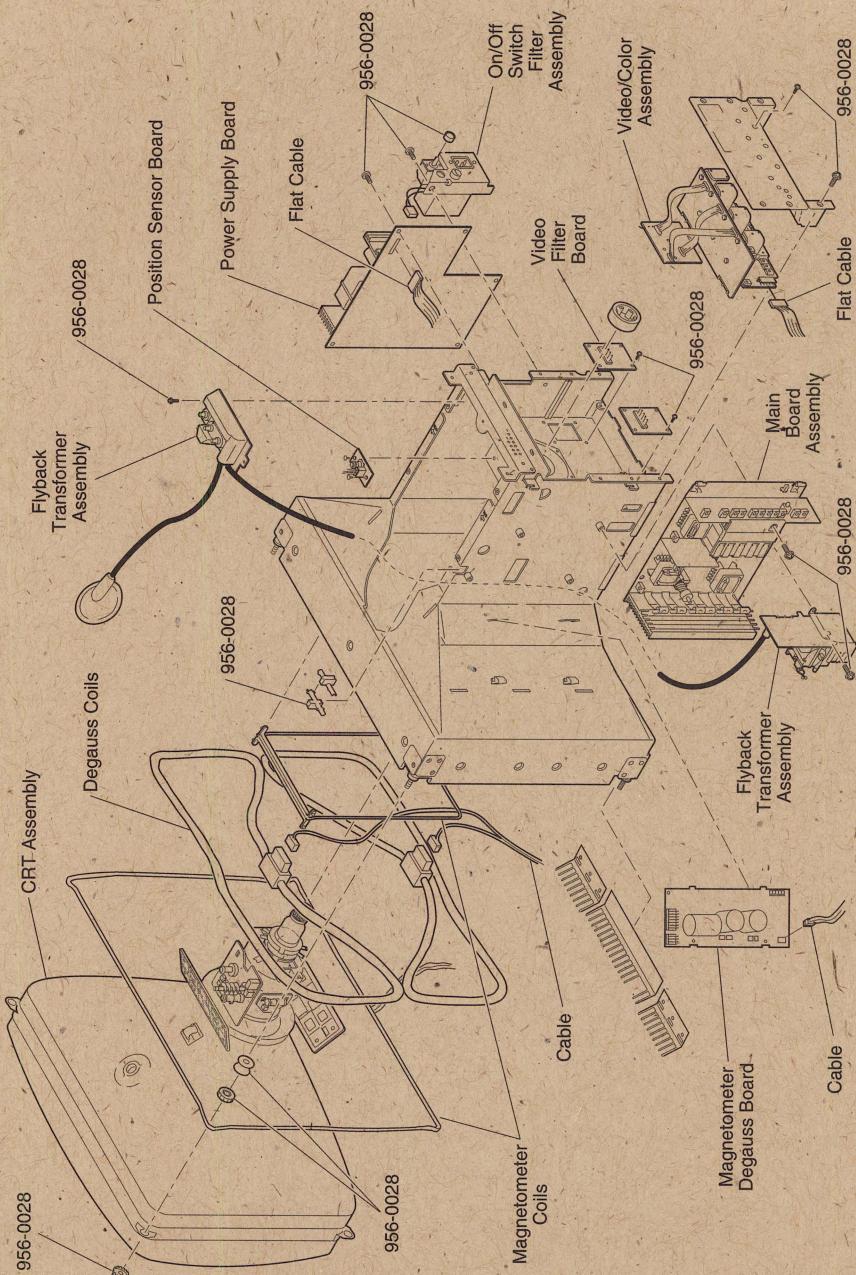
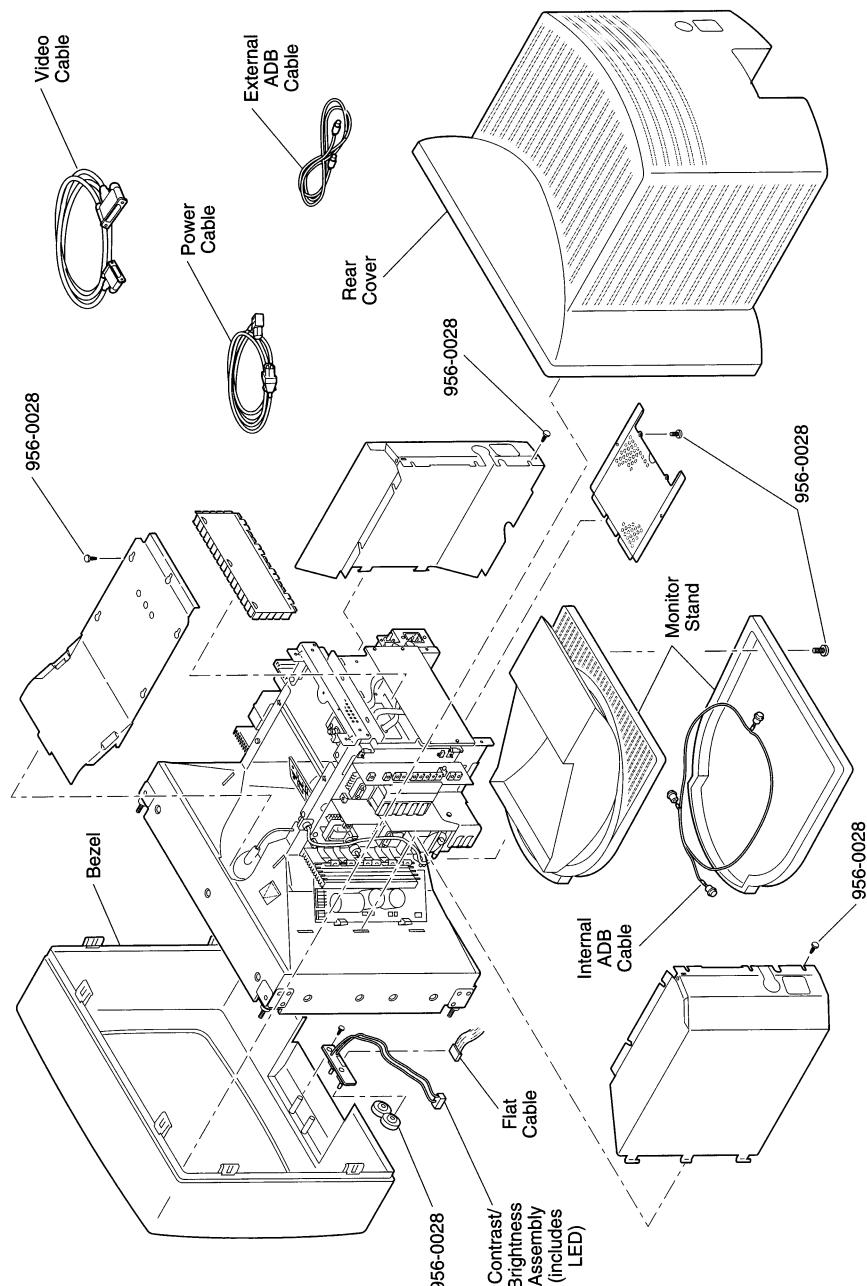


Figure 1 Macintosh 21-Inch Color Display Exploded View



**Figure 2 Macintosh 21-Inch Color Display Exploded View**

---

Cables	
Cable, degauss coil to magnetometer degauss board.....	590-0466
Cable, external ADB, CPU to tilt-swivel monitor stand.....	590-4501
Cable, external power, 110 V, domestic .....	590-0373
Cable, external power, 220 V, international .....	590-0423
Cable, flat, contrast/brightness assembly to video filter board.....	590-0468
Cable, flat, main board to video assembly.....	590-0470
Cable, flat, power supply to video filter board and main board .....	590-0469
Cable, internal ADB, tilt/swivel monitor stand .....	590-0626
Cable, position sensor to magnetometer degauss board.....	590-0467
Cable, video, DA-15 to DB-25 (CPU to monitor) .	590-0615
Case and stand parts	
Bezel.....	949-0330
Rear cover .....	949-0331
Screw/knob set.....	956-0028
Tilt-swivel monitor stand .....	949-0329
Coils	
Degauss coils, upper/lower .....	076-0405
Magnetometer coils, front/rear (w/bridge) .....	076-0403
CRT assemblies	
CRT assembly .....	076-0394
CRT assembly, reversed polarity .....	076-0402
Other component assemblies	
Contrast/brightness assembly (includes LED).....	905-0011
Flyback transformer assembly .....	076-0399
On/off switch filter assembly.....	076-0398
Video/color assembly.....	661-0655
Printed circuit boards	
Magnetometer degauss board.....	661-0657
Main board assembly .....	661-0656
Position sensor board.....	982-0096
Power supply board.....	661-0658
Video filter boards, left/right .....	076-0404

---

## Troubleshooting

---

### Symptom/Cure Chart

Use the following chart as a troubleshooting guide. If the first corrective action does not solve the problem, reinstall the original module before proceeding to the next step. When troubleshooting, remember that environmental distortions are common and cannot be corrected by monitor adjustments or module replacement. For information on environmental distortions, see the General Monitor Information chapter.

No Raster	Solutions
No raster, LED off	<ol style="list-style-type: none"><li>1. Check that the power cord is properly connected.</li><li>2. Check the internal power connectors.</li><li>3. Refer to Using Troubleshooting LEDs later in this chapter.</li></ol>
No raster, LED on	<ol style="list-style-type: none"><li>1. Adjust the contrast and brightness controls.</li><li>2. Verify that the video card (in the CPU) is working properly.</li><li>3. Verify that all connectors are secure on the main board and the power supply board.</li><li>4. Refer to Using Troubleshooting LEDs later in this chapter.</li></ol>
<b>Geometric Problems<sup>1</sup></b>	
Raster size too short/tall, narrow/wide	<ol style="list-style-type: none"><li>1. Adjust the vertical or horizontal size controls (as appropriate) on the main board assembly.</li><li>2. Replace the main board assembly.</li></ol>
Raster not centered	<ol style="list-style-type: none"><li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li><li>2. Adjust the horizontal shift or vertical shift controls.</li><li>3. Replace the main board assembly.</li><li>4. Replace the magnetometer degauss board.</li></ol>
Horizontal linearity bad (size of text/graphics differs at sides of screen)	<ol style="list-style-type: none"><li>1. Adjust the horizontal linearity control on the main board assembly.</li><li>2. Replace the main board assembly.</li></ol>
Vertical linearity bad (size of text/graphics differs at top/bottom of screen)	<ol style="list-style-type: none"><li>1. Adjust vertical linearity control on main board assembly.</li><li>2. Replace the main board assembly.</li></ol>
Raster tilted	<ol style="list-style-type: none"><li>1. Verify that distortion is not due to environmental conditions (move monitor to a different location).</li><li>2. Perform the horizontal shift or vertical shift adjustments.</li><li>3. Replace the magnetometer degauss board.</li><li>4. Replace the position sensor board.</li></ol>

---

<sup>1</sup> Remember, slight geometric distortion problems cannot be solved by replacing modules.

---

Abnormal/distorted raster: • barrel-shaped • corners not square • stretched or compressed at top of display • sides not perpendicular	<ol style="list-style-type: none"> <li>Verify that distortion is not due to environmental conditions (move monitor to a different location).</li> <li>Verify that all connectors are correctly placed and secure.</li> <li>Refer to Using Troubleshooting LEDs later in this chapter.</li> <li>Perform the appropriate geometric adjustments.</li> <li>Replace the main board assembly.</li> <li>Replace the magnetometer degauss board.</li> </ol>
<b>Synchronization Problems</b>	<b>Solutions</b>
Picture breaks in diagonal lines	<ol style="list-style-type: none"> <li>Connect another monitor to the computer and switch power on to verify that a video signal is coming from the computer.</li> <li>Replace the main board assembly.</li> </ol>
Picture rolls vertically	<ol style="list-style-type: none"> <li>Verify that the video card (in the CPU) is working properly.</li> <li>Replace the main board assembly.</li> <li>Replace the video/color assembly.</li> </ol>
Picture breaks and rolls horizontally	<ol style="list-style-type: none"> <li>Verify that the video card (in the CPU) is working properly.</li> <li>Perform the horizontal hold adjustment.</li> <li>Replace the main board assembly.</li> <li>Replace the video/color assembly.</li> </ol>
Single vertical or horizontal line appears	<ol style="list-style-type: none"> <li>Verify that the CRT video board is tight on yoke connector.</li> <li>Replace the main board assembly.</li> </ol>
<b>Video/Color Problems</b>	<b>Solutions</b>
Predominant red, blue, or green tint	<ol style="list-style-type: none"> <li>Verify that the video card (in the CPU) is working properly.</li> <li>Perform the video adjustments.</li> <li>Replace the video/color assembly.</li> <li>Replace the video filter boards.</li> <li>CRT may be defective.</li> </ol>
Picture too dark or too bright	<ol style="list-style-type: none"> <li>Adjust the brightness and contrast controls.</li> <li>Verify that the video card (in the CPU) is working properly.</li> <li>Perform the video adjustments.</li> <li>Replace the power supply board.</li> <li>Replace the video/color assembly.</li> <li>Replace the video filter boards.</li> <li>CRT may be defective.</li> </ol>
Out of focus	<ol style="list-style-type: none"> <li>Perform the focus adjustments.</li> <li>Replace the flyback transformer assembly.</li> <li>Replace the main board assembly.</li> <li>CRT may be defective.</li> </ol>

---

Out of convergence (color bleeding out from text or lines)	<ol style="list-style-type: none"> <li>1. Verify that the video card (in the CPU) is working properly.</li> <li>2. Perform the convergence adjustments.</li> <li>3. CRT may be defective.</li> </ol>
<b>Misc. Problems</b>	<b>Solutions</b>
Intermittent shutdown	<ol style="list-style-type: none"> <li>1. Replace the flyback transformer assembly.</li> <li>2. Replace the main board assembly.</li> </ol>
Picture jitters or flashes	<ol style="list-style-type: none"> <li>1. Verify that all grounding cables are secure.</li> <li>2. Confirm that adjacent computer equipment is properly grounded. Move electrical devices away from the monitor. Temporarily shut off all fluorescent lights in the area.<sup>2</sup></li> <li>3. Replace the main board assembly.</li> </ol>
Black screen spots (burnt phosphor)	<ul style="list-style-type: none"> <li>– CRT may be defective.</li> </ul>
Monitor emits high-pitched noise	<ul style="list-style-type: none"> <li>– Replace the flyback transformer assembly.</li> </ul>
Does not degauss	<ol style="list-style-type: none"> <li>1. Replace the magnetometer degauss board.</li> <li>2. Replace the position sensor board.</li> </ol>
Erratic or no communication with ADB device	<ol style="list-style-type: none"> <li>1. Replace the keyboard cable, keyboard, mouse, or other ADB device.</li> <li>2. Replace the ADB cable in monitor stand.</li> </ol>

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<sup>2</sup> External electrical interference problems cannot be solved by monitor adjustments or replacement of modules.

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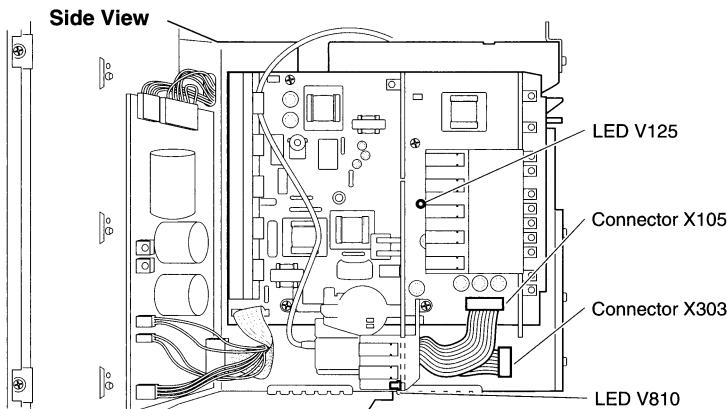
## Using Troubleshooting LEDs

You can obtain additional troubleshooting information through a series of LEDs located on the main board and the power supply board. Use Figures 3–6 to interpret the information given by the LEDs.

### Main Board LEDs

The main board has two troubleshooting LEDs (see Figure 3). The LEDs monitor different functions:

- LED 125 monitors the presence of horizontal and vertical sweeps. Its normal state is on.
- LED 810 monitors the presence of high-voltage. Its normal state is on.

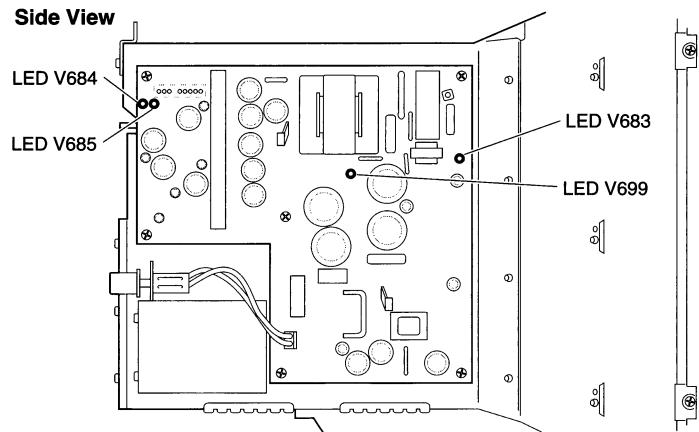


**Figure 3 Troubleshooting LEDs on the Main Board**

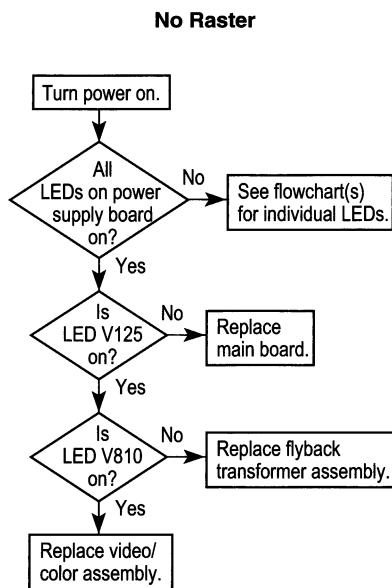
### Power Supply Board LEDs

The power supply board has four troubleshooting LEDs (see Figure 4). The LEDs monitor a variety of functions:

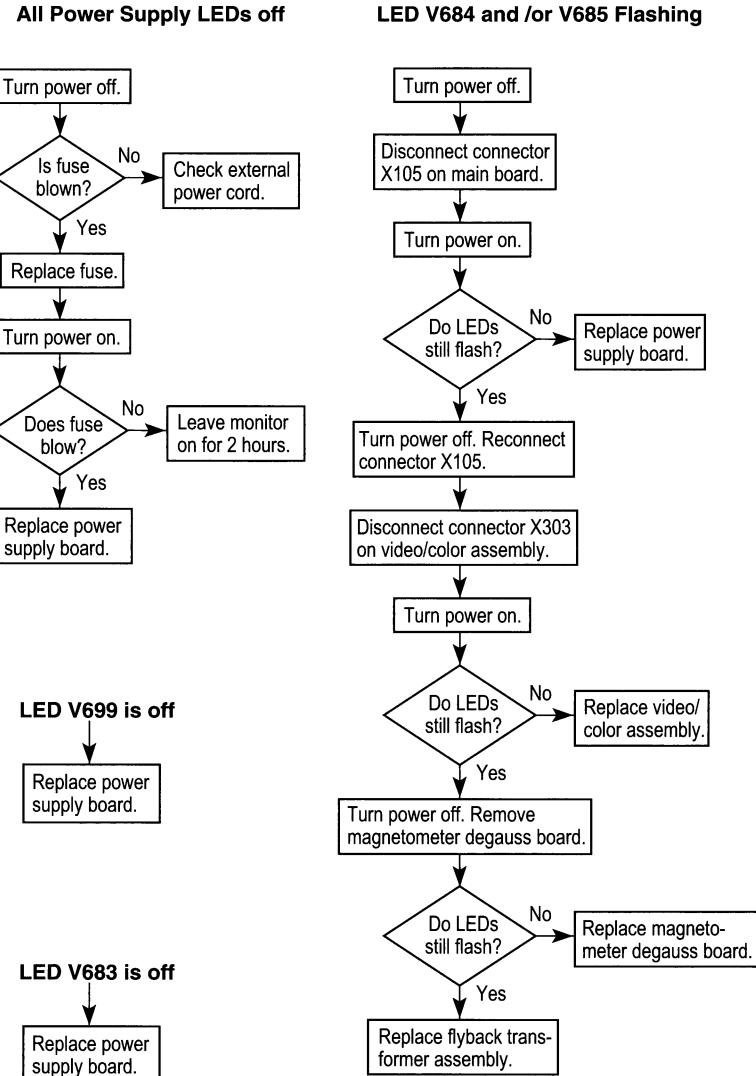
- LED 683 monitors the power supply board. Its normal state is on.
- LED 699 monitors the voltage level. Its normal state is on.
- LEDs 684 and 685 monitor a number of conditions (see Figure 6). Their normal state is on (static, not flashing).



**Figure 4 Troubleshooting LEDs on the Power Supply Board**



**Figure 5 General Troubleshooting LEDs Flowchart**



**Figure 6 Power Supply Board Troubleshooting LEDs Flowchart**

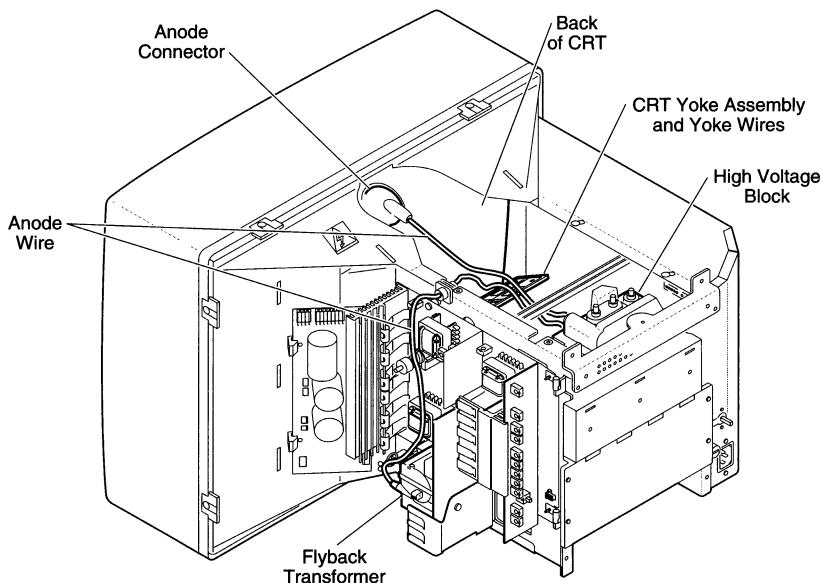
## Safety Instructions

**▲ Warning** **The Macintosh 21-Inch Color Display contains a high-vacuum picture tube and operates at very high voltages. To prevent serious injury, review the CRT safety rules before performing adjustments.**

In addition to following all safety precautions, be sure to:

- **Never** use a grounding wriststrap or work on a grounded workpad when adjusting an operating monitor.
- Keep one hand behind your back at all times, and grasp the handle of the insulated alignment tool with your other hand.
- Use a mirror for viewing adjustment results.
- Perform only those adjustments that are absolutely necessary. Do not attempt to make any adjustments other than the ones explained in this section, and do those with extreme caution.

**▲ Warning** **Serious injury could result if, with the power on, you touch any of the high-voltage areas shown in Figure 7.**



**Figure 7 High-Voltage Areas**

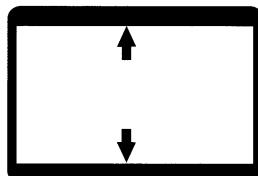
## Adjustments

### Geometric Alignment and Convergence Charts

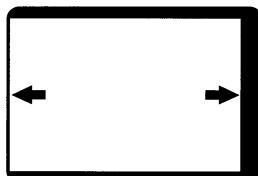
Use Figure 8 and Figure 9 as quick reference guides for geometric alignment and convergence adjustments.



Raster too wide or too narrow



Raster too tall or too short

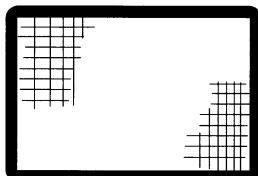


Raster shifted left or right

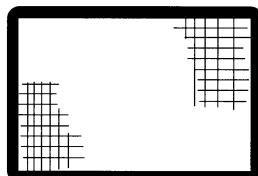
Adjust H-SIZE (R93) to  
371 mm  $\pm$  3 mm

Adjust V-SIZE (R52) to  
280 mm  $\pm$  3 mm

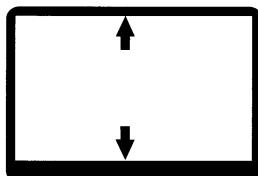
Adjust H-PHASE (R262)  
and H-DC SHIFT (R116)



Rectangles of different size  
at left and right sides



Rectangles of different size  
at top and bottom

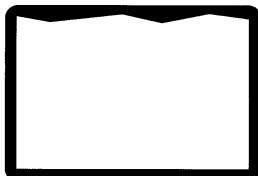


Raster shifted up or down

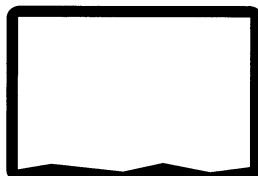
Adjust H-LIN (R101)

Adjust V-LIN (R26)

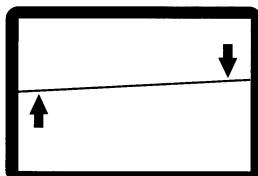
Adjust V-SHIFT (R75)



Raster not straight at top



Raster not straight at bottom

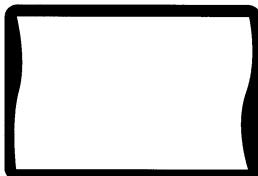


Centerline not horizontal

Adjust N/S PHASE (R262) and  
N/S TRAP (R69)

Adjust N/S (R34) and  
N/S BAL (R28)

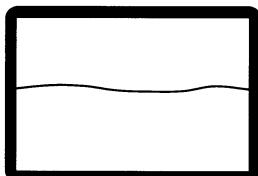
Adjust N/S TILT (R74)



Raster not straight at left or  
right



Raster not vertical at left or  
right



Centerline not straight

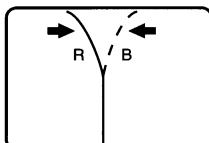
Figure 8 Geometric Alignment Chart

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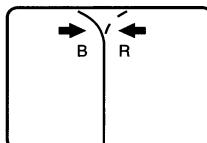
Perform the adjustment that corrects your specific convergence problem. If you are unable to fix the problem, perform the adjustments in the order presented in Figure 9.

Step 1: H-STATIC (Controls all vertical lines; not shown)

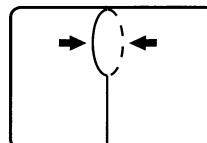
Step 2: V-STATIC (Controls all horizontal lines; not shown)



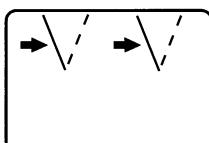
Step 3: Adjust VR3



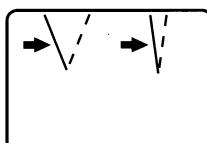
Step 4: Adjust VR2



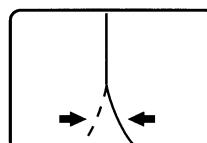
Step 5: Adjust VR5



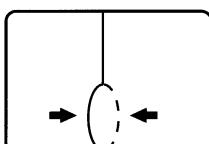
Step 6: Adjust AMP-T



Step 7: Adjust TILT-T



Step 8: Adjust VR4



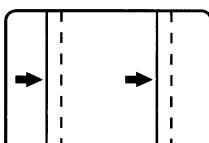
Step 9: Adjust VR6



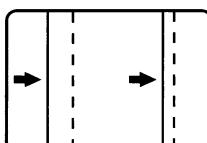
Step 10: Adjust AMP-B



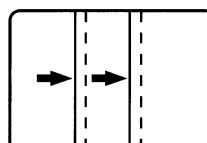
Step 11: Adjust TILT-B



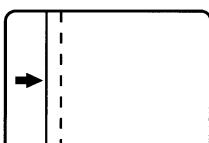
Step 12: Adjust H-RIGHT



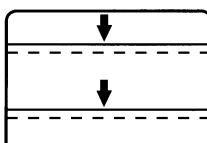
Step 13: Adjust H-LEFT1



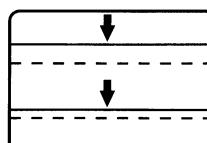
Step 14: Adjust H-LEFT2



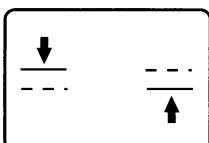
Step 15: Adjust 1/2W



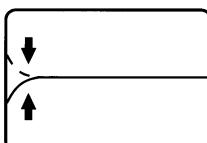
Step 16: Adjust V-NS



Step 17: Adjust V-N



Step 18: Adjust V-EW



Step 19: Adjust V-W

**Figure 9 Convergence Chart**

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## **Geometric Adjustments**

Geometric adjustments include horizontal, vertical, convergence, and focus adjustments. To correct geometric adjustment problems, refer to the Geometric Alignment Chart in this section and perform the adjustment that corrects your specific geometric adjustment problem. If you are unable to fix the problem, perform the geometric adjustments in the order presented.

### **Materials Required**

#### **Compass**

Plastic adjustment tool or insulated screwdriver

Hex-head, plastic adjustment tool

Linearity adjustment tool

Flexible metric ruler

Light meter (Sekonic Multi-Lumi, model L-248)

#### **Voltmeter**

Small insulated flat-blade screwdriver, no longer than three inches

21-Inch Color Display diagnostic overlay (076-0444)

#### **Masking tape**

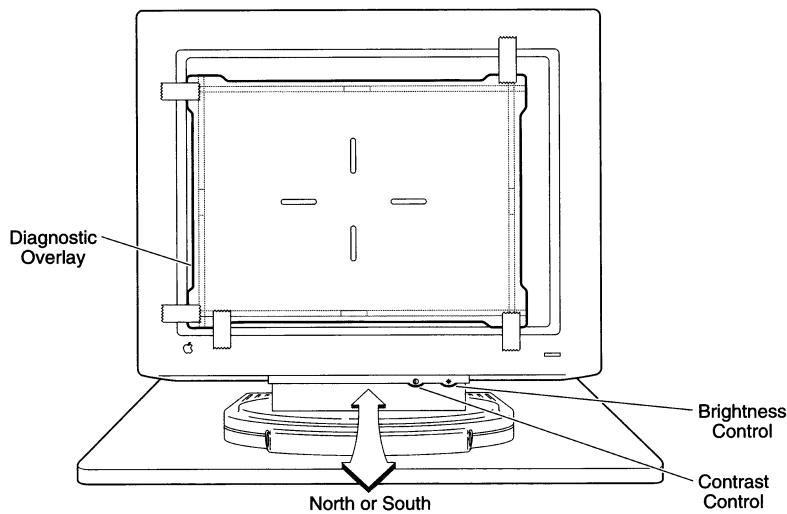
Appropriate diagnostic (See the Monitor Diagnostics table in the General Monitor Information chapter.)

## **Setup**

1. Switch off the monitor and place the monitor on a protective workbench pad.
2. Remove the rear cover and the main board access panel.
3. Align the monitor to magnetic north or south.
  - Using a compass, locate magnetic north or south on the workbench pad.
  - Place the monitor on the pad with the front bezel and the front of the monitor stand facing magnetic north or south.
  - Place the compass squarely on the front bezel. Swivel the bezel left or right until the compass reads magnetic north or south.
4. Switch on the monitor and let it warm up for at least 15 minutes.

---

5. FIGURE 10. Tilt the monitor up approximately 5 degrees and install the diagnostic overlay on the bezel, as follows:
  - Slide the overlay down until it is flush with the bottom edge of the bezel, and then slide the overlay left until it is flush with the left edge of the bezel.
  - Use masking tape to tape the overlay to the bezel.
6. FIGURE 10. Set the brightness control to detent (midrange) and the contrast control to maximum (turn clockwise).



**Figure 10 Setting the Contrast and Brightness Controls**

---

## Horizontal and Vertical Adjustments

### Horizontal Size

1. Display geometry adjustment pattern 5, East/West bars.
2. FIGURE 11. Adjust the H-SIZE control until the raster is 371 mm ( $\pm 3$  mm) or 14 11/16" ( $\pm 1/8"$ ) wide.

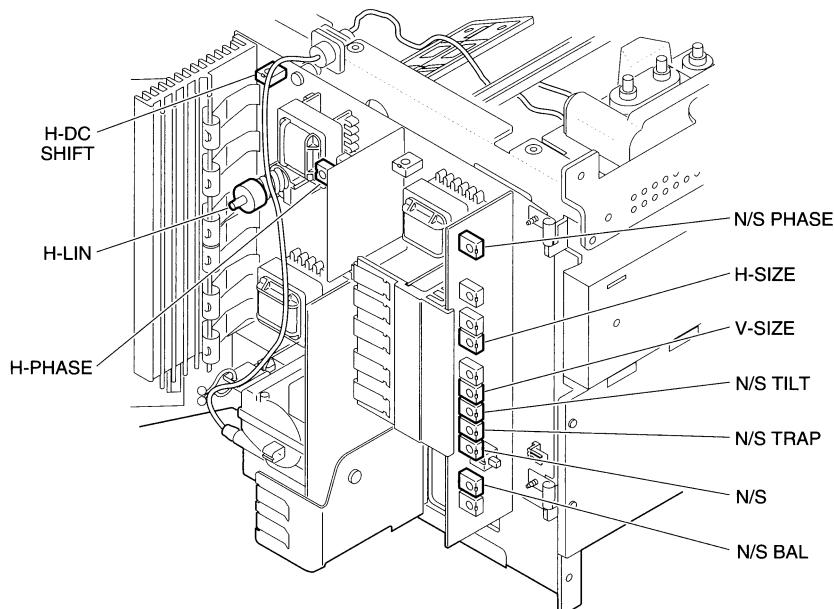
**Note** Horizontal size and vertical size must be within 3 mm (or 1/8") of the recommended measurements.

### Vertical Size

1. Display geometry adjustment pattern 3, North/South bars.
2. FIGURE 11. Adjust the V-SIZE control until the raster is 280 mm ( $\pm 3$  mm) or 11" ( $\pm 1/8"$ ) high.

### Horizontal Phase

1. Display geometry adjustment pattern 5, East/West bars.
2. FIGURE 11. Turn the H-PHASE control counterclockwise until the left edge of the left bar begins to wrap at the left edge of the screen. Then turn the H-PHASE control



**Figure 11 Vertical and Horizontal Adjustment Controls**

---

clockwise until the right bar stops at the right edge of the screen. Then center the H-PHASE control at midrange between these two points.

### **Horizontal Shift**

- FIGURE 11. Adjust the H-DC SHIFT control until the left and right bars are in the center of the screen.

### **Horizontal Linearity**

1. Display geometry adjustment pattern 1, crosshatch.
2. FIGURE 11. Using the linearity adjustment tool and flexible ruler, adjust the H-LIN control until the rectangles on the left and right side of the raster are the same size. If necessary, readjust the H-DC SHIFT control.

### **North/South Phase**

1. Display geometry adjustment pattern 3, North/South bars.
2. FIGURE 11. Adjust the N/S PHASE control until the top and bottom horizontal lines are as straight as possible.

### **North/South Trapezoid**

- FIGURE 11. Adjust the N/S TRAP control until the topmost and bottommost lines are parallel. This adjustment fine-tunes N/S PHASE.

### **North/South Tilt**

1. Display geometry adjustment pattern 4, centerline.
2. FIGURE 11. Adjust the N/S TILT control until the centerline is horizontal.

### **North/South Amplitude**

1. Display geometry adjustment pattern 3, North/South bars.
2. FIGURE 11. Adjust the N/S control until the top and bottom horizontal lines are as straight as possible.

#### **Note**

When adjusting the N/S and N/S BAL controls, make the top and bottom horizontal lines as straight as possible.

### **North/South Balance**

- FIGURE 11. Adjust the N/S BAL control until the top and bottom horizontal lines are as straight as possible.

### Vertical Linearity

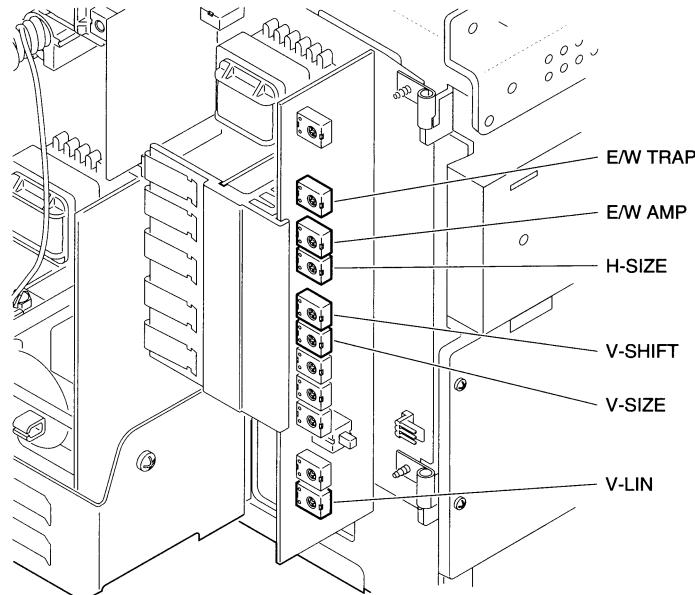
1. Display geometry adjustment pattern 1, crosshatch.
2. FIGURE 12. Adjust the V-LIN control until the height of the squares at the top and bottom of the crosshatch pattern are the same.

### Vertical Shift

1. Display geometry adjustment pattern 3, North/South bars.
2. FIGURE 12. Adjust the V-SHIFT control until the top and bottom bars are positioned in the vertical center of the screen.

### Vertical Size

- FIGURE 12. Adjust the V-SIZE control until the raster is 280 mm ( $\pm 3$  mm) or 11" ( $\pm 1/8"$ ) high.



**Figure 12 Geometric Adjustment Controls**

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### East/West Amplitude

1. Display geometry adjustment pattern 5, East/West bars.
2. FIGURE 12. Adjust the E/W AMP control until the left and right vertical lines are straight.

### East/West Trapezoid

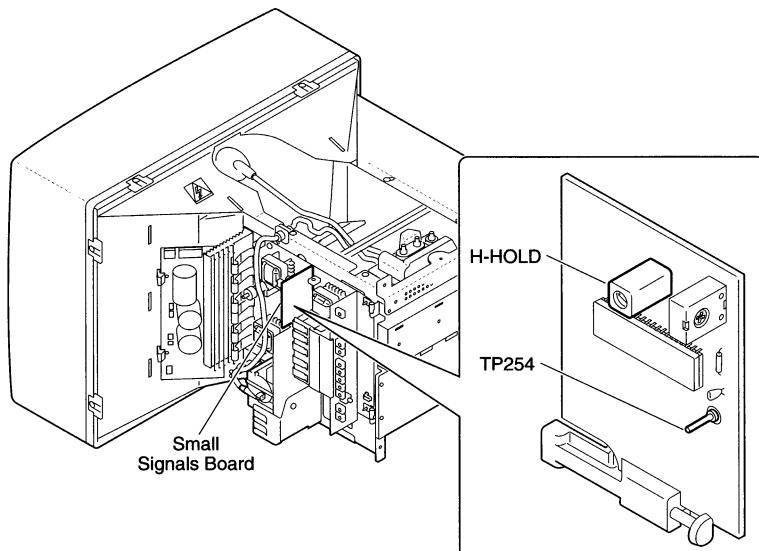
- FIGURE 12. Adjust the E/W TRAP control until the left and right vertical lines are parallel.

### Horizontal Size

- FIGURE 12. Adjust the H-SIZE control until the raster is 371 mm ( $\pm 3$  mm) or 14 11/16" ( $\pm 1/8"$ ) wide.

### Horizontal Hold

1. Display geometry adjustment pattern 2, all-white screen.
2. FIGURE 13. Using the short (three-inch) insulated screwdriver and voltmeter, adjust the H-HOLD control until the voltmeter reads 4.1 volts ( $\pm 0.2$  V) at TP254.



**Figure 13 Horizontal Hold Adjustment Control and Test Point**

## Convergence

Convergence is properly adjusted when the red and blue lines of the crosshatch pattern are precisely aligned to the green line. When the red, blue, and green lines are precisely aligned, you will see only a thin white line.

To correct convergence adjustment problems, refer to the Convergence Chart in this section and perform the adjustment that corrects your specific convergence problem. If you are unable to fix the problem, perform the convergence adjustments in the order presented.

**Important** It is not always possible to precisely align convergence at every point on the screen. Rather, try to attain the best overall alignment with each convergence control.

### H-Static

1. Display convergence adjustment pattern 1, crosshair lines.
2. FIGURE 14. Adjust the H-STATIC control on the magnetometer degauss board until the red and blue vertical lines in the center of the crosshair pattern are aligned as precisely as possible.

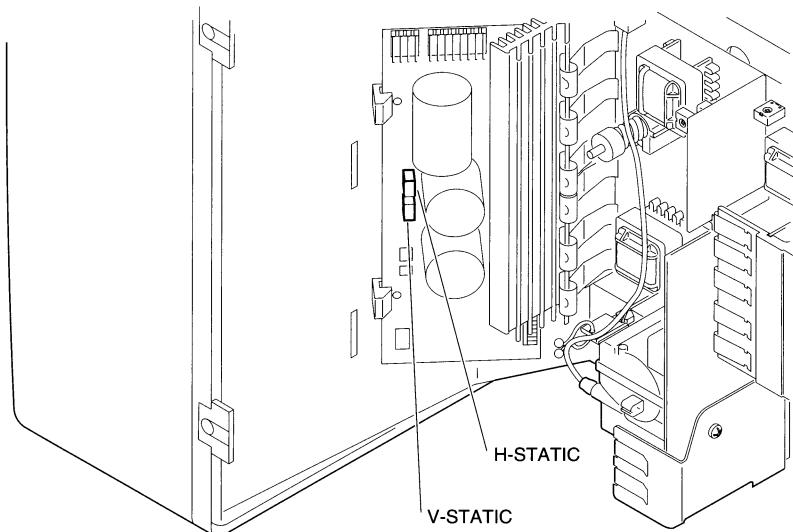


Figure 14 H-STATIC and V-STATIC Controls

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### V-Static

1. FIGURE 14. Adjust the V-STATIC control on the magnetometer degauss board until the red and blue horizontal lines in the center of the crosshair pattern are aligned as precisely as possible.
2. Display convergence adjustment pattern 2, crosshatch and recheck the screen for convergence problems. If screen convergence is now OK, stop here.

### VR3

1. Remove the CRT access cover and display the convergence adjustment pattern 3, vertical lines at top.

**▲ Warning**

**When removing the access panels with power on, keep in mind that serious injury could result if you touch any of the high-voltage components.**

2. FIGURE 15. Adjust the VR3 control until the red and blue vertical lines are not visible in the top 2 inches (50 mm).

### VR2

- FIGURE 15. Adjust the VR2 control until the red and blue vertical lines are not visible in the top 1/4 inch (5 mm).

### VR5

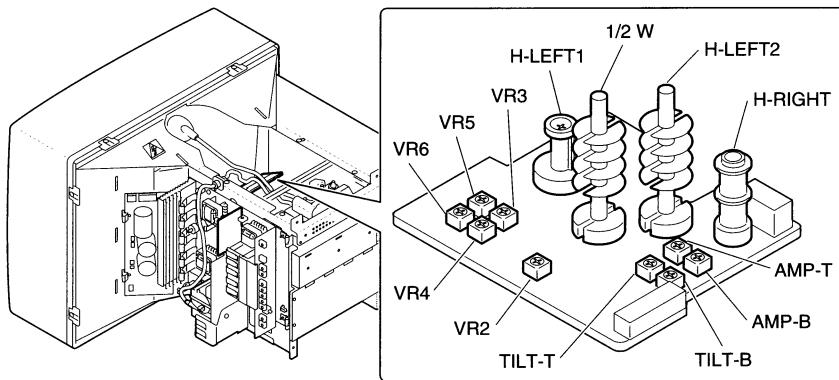
- FIGURE 15. Adjust the VR5 control until the red and blue vertical lines are not visible in the upper four inches (100 mm).

### AMP-T

**Note**

Use the AMP-T and TILT-T controls interactively to correct problems with the tops of the vertical lines at the left and right sides of the vertical-lines-at-top pattern. If the AMP-T control does not correct the problem, use the TILT-T control to correct the problem, or use TILT-T to misalign both sides equally and then return to the AMP-T control to correct the problem.

- FIGURE 15. Use the AMP-T control to adjust the top two inches (50 mm) of the leftmost and rightmost red and blue vertical lines.



**Figure 15 Convergence Adjustment Controls**

#### TILT-T

- FIGURE 15. Use the TILT-T control to adjust the red and blue vertical lines at the top-left and top-right sides of the screen. The TILT-T control affects lines at the top-left side of the screen more than it affects lines at the top-right. You may need to return to the AMP-T control to complete this adjustment.

#### VR4

1. Display convergence adjustment pattern 4, vertical lines at bottom.
2. FIGURE 15. Adjust the VR4 control until red and blue vertical lines are not visible in the bottom two inches (50 mm).

#### VR6

- FIGURE 15. Adjust the VR6 control until red and blue vertical lines are not visible in the bottom four inches (100 mm).

---

### **AMP-B**

- FIGURE 15. Use the AMP-B control to adjust the bottom two inches (50 mm) of the leftmost and rightmost red and blue vertical lines.

**Note** Use the AMP-B and TILT-B controls interactively to correct problems with the bottoms of the vertical lines at the left and right sides of the crosshatch pattern.

### **TILT-B**

- FIGURE 15. Use the TILT-B control to adjust the red and blue vertical lines at the bottom-left and bottom-right sides of the screen. The TILT-B control affects lines at the bottom-left side of the screen more than it affects lines at the bottom-right. You may need to return to the AMP-B control to complete this adjustment.

### **H-RIGHT**

1. Display convergence adjustment pattern 5, vertical lines at sides.

**Note** H-RIGHT, H-LEFT1, and H-LEFT2 move the vertical lines left or right. H-RIGHT and H-LEFT1 work together to align the red and blue vertical lines to the white/green lines at the left and right edges of the vertical-lines-at-sides test pattern. If H-RIGHT precisely aligns the leftmost and rightmost vertical lines, skip the H-LEFT1 adjustment; if H-RIGHT does not precisely align the left and right vertical lines, perform the H-LEFT1 adjustment and then repeat the H-RIGHT adjustment.

2. FIGURE 15. Using the hex-head adjustment tool, adjust the H-RIGHT control until the red and blue vertical lines at the left and right edges are not visible. If the blue and red vertical lines at either side remain visible, perform the H-LEFT1 adjustment.

---

## H-LEFT1

- FIGURE 15. Adjust the H-LEFT1 control until the blue vertical lines at the left and right edges are equally distance from the green/white lines. Now repeat the H-RIGHT adjustment.

**Note**

H-LEFT1 controls the blue gun only and adjusts the blue lines on the left side of the screen further than the blue lines on the right. The objective is to use the H-LEFT1 control to misalign equally the blue lines at the left and right edges of the screen. With the left and right blue lines at equal distances from the left and right white lines, you can then use the H-RIGHT control to bring both blue lines into adjustment.

## H-LEFT2

- FIGURE 15. Using the hex-head adjustment tool, adjust the H-LEFT2 control until the red and blue vertical lines are not visible in an area approximately 3–5 inches (75–125 mm) from the left and right edges of the screen. This adjustment finetunes the H-RIGHT and H-LEFT1 adjustments.

## 1/2W

- FIGURE 15. Adjust the 1/2W control until the red and blue vertical lines on the left third of the pattern are not visible.

## V-NS

1. Display convergence adjustment pattern 6, horizontal lines at top and bottom.

**Note**

V-NS and V-N move the horizontal lines up or down. These controls work together to align the red and blue horizontal lines to the white/green lines at the top and bottom edges of the pattern. If V-NS precisely aligns the top and bottom horizontal lines, skip the V-N adjustment. If V-NS does not precisely align the top and bottom horizontal lines, perform the V-N adjustment and then repeat the V-NS adjustment.

---

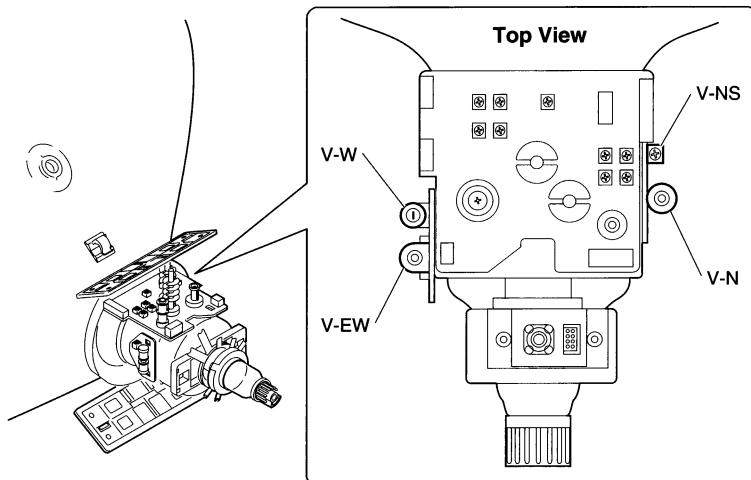
2. FIGURE 16. Adjust the V-NS control until red and blue horizontal lines at the top and bottom edges are not visible. If the blue and red horizontal lines at the top or bottom of the screen remain visible, perform the V-N adjustment.

### V-N

- FIGURE 16. Using the hex-head adjustment tool, adjust the V-N control until the blue horizontal lines at the top and bottom edges of the crosshatch pattern are equally distant from the green/white lines. Now repeat the V-NS adjustment.

#### Note

The V-N adjustment controls the blue gun only and adjusts the blue lines on the top of the screen further than the blue lines on the bottom. **The objective is to use the V-N control to misalign equally the blue lines at the top and bottom edges of the screen.** With the top and bottom blue lines at equal distances from the top and bottom white lines, you can then use the V-NS control to bring both blue lines into adjustment.



**Figure 16 Convergence Adjustment Controls**

---

## V-EW

1. Display convergence adjustment pattern 1, crosshair lines.

### Note

The V-EW control rotates the red and blue guns around an imaginary axis in the center of the screen. Use this control to align the centermost horizontal lines at the left and right edges of the screen.

2. FIGURE 16. Using the hex-head adjustment tool, adjust the V-EW control until the centermost red and blue horizontal lines are not visible at the left and right edges of the crosshair pattern.

## V-W

1. Display convergence adjustment pattern 7, horizontal lines at left.
2. FIGURE 16. Adjust the V-W control until the red and blue horizontal lines are not visible at the left end of the center horizontal line. This is a very fine adjustment.

## Focus

Make focus adjustments on the main board assembly and the high-voltage block of the flyback transformer assembly.

1. Remove the CRT access cover and display focus adjustment pattern 1, crosshatch.

### ▲ Warning

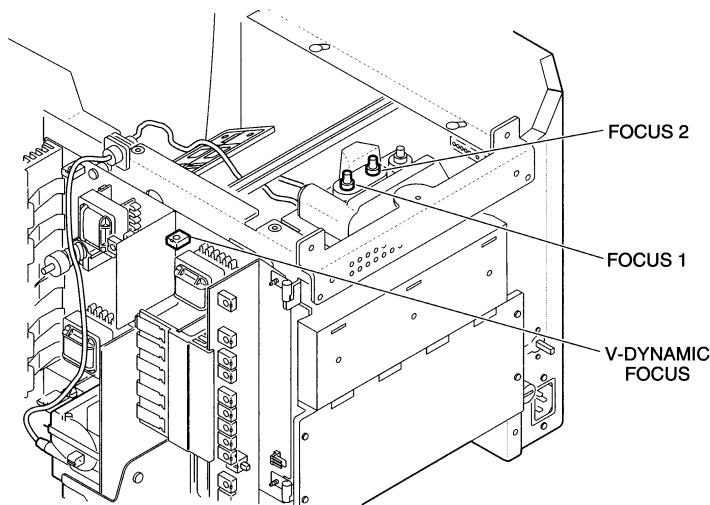
**When removing the access panels with power on, keep in mind that serious injury could result if you touch any of the high-voltage components.**

---

2. FIGURE 17. Turn the V-DYNAMIC FOCUS (R155) control on the main board clockwise to its limit.
3. FIGURE 17. Adjust the FOCUS2 control on the high-voltage block until the center vertical line is as small as possible.
4. FIGURE 17. Adjust the FOCUS1 control on the high-voltage block until the center horizontal line is as small as possible.

---

5. FIGURE 17. Check the horizontal lines at the top and bottom of the screen for precise focus. If the horizontal lines are not precisely focused, back off (turn counterclockwise) the V-DYNAMIC FOCUS (R155) control on the main board until the horizontal lines are as small as possible.
6. Display focus adjustment pattern 2, percent signs.
7. FIGURE 17. Check the corners of the percent signs pattern for precise focus. If parts of the screen are not precisely focused, adjust the FOCUS1 control for the best overall focus.



**Figure 17 Focus Adjustment Controls**

---

## **Video Adjustments**

Make sure you have performed any necessary geometric adjustments before performing the video adjustments. Perform the video adjustments only if the color quality is unacceptable.

### **Checking Display Video**

1. Display video pattern 1, gray bars.
2. Set the brightness control to detent (midrange) and the contrast control to maximum (turn clockwise).
3. Check that the following conditions are true:
  - There is no predominant color in the gray bars.
  - The leftmost (brightest) bar measures at the middle of the "9" scale on the light meter.
  - The rightmost (darkest) three bars are, respectively, black (furthest-right bar), barely visible, and dark gray.

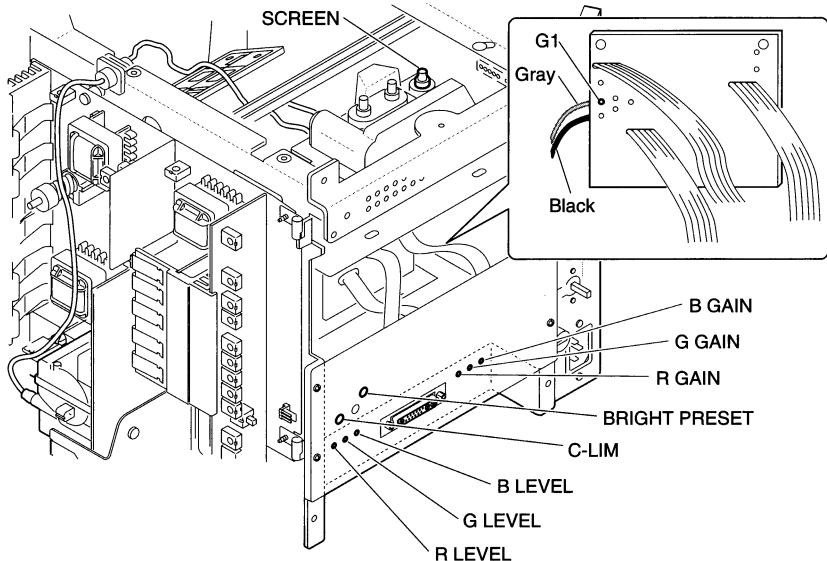
If these conditions are not met, perform the video adjustment procedure that follows.

### **Video Adjustment Procedure**

**▲ Warning**

**When removing the access panels with power on, keep in mind that serious injury could result if you touch any of the high-voltage components.**

1. Switch off monitor power, place the monitor on a protective workbench pad, and remove the rear cover, the CRT access panel, and the CRT/video board access cover.
2. Switch on the monitor and let the monitor warm up for at least 15 minutes.
3. Align the monitor to magnetic north or south.
4. Display video adjustment pattern 2, all-black screen.
5. Set the brightness control to maximum brightness (full clockwise) and set the contrast control to minimum contrast (full counterclockwise).



**Figure 18 Video Adjustment Controls**

6. FIGURE 18. Preset the following adjustment controls to minimum (full counterclockwise).
  - SCREEN
  - C-LIM
  - BRIGHT PRESET
  - R,G, and B GAIN
  - R,G, and B LEVEL
  
7. FIGURE 18. Using the voltmeter and the insulated screwdriver, adjust the BRIGHT PRESET control to increase the G1 voltage by 4 volts ( $\pm 0.2$  V).

**Note**

Voltage at G1 is negative. Thus, for example, if the initial voltmeter reading is -61 volts, adjust BRIGHT PRESET until the reading is -57 volts to increase voltage by 4 volts.

---

8. FIGURE 18. Adjust the SCREEN control until the raster just appears. (The entire screen should be obviously tinted, but very dark.)
9. Set the brightness control to detent (midrange) and the contrast control to maximum (full clockwise).
10. FIGURE 18. Adjust the red, green, and blue GAIN controls to midrange.
11. FIGURE 18. Adjust the BRIGHT PRESET control to minimum (full counterclockwise).
12. Display video adjustment pattern 3, all-white screen.
13. Set the light meter so that the lower scale reads 2 through 10.
14. FIGURE 18. Adjust the C-LIM control until the center of the all-white screen measures in the middle of the "9" scale on the light meter.

**Note** If you cannot attain a "9" reading on the light meter using the C-LIM control, turn up (clockwise) the three GAIN controls by 1/4 turn and repeat step 14.

15. Display video adjustment pattern 1, gray bars.
16. FIGURE 18. Alternately increase the red and blue LEVEL controls until there is no predominant color (no colored tint) in the right (darkest) five bars. Use the green LEVEL control only if you cannot obtain a proper adjustment using the red and blue LEVEL controls.
17. FIGURE 18. Alternately adjust the three gain controls—R GAIN, G GAIN, and B GAIN—until there is no predominant color (no colored tint) in the left (brightest) five bars.
18. Recheck the right (darkest) five bars for a predominant color. If necessary, repeat steps 16 and 17 until there is no predominant color anywhere on the screen.
19. FIGURE 18. Adjust the SCREEN control until the rightmost bar is black (it should match the screen border), and the second bar from the right is barely visible.

**Note** If the SCREEN control cannot be set properly in the preceding step, stop the adjustment procedure and refer to Troubleshooting in this section.

20. If the screen again has a predominant color, repeat steps 16 to 19.

---

21. Display video adjustment pattern 3, all-white screen.
22. Recheck screen luminance with the light meter. If the light meter does not read in the middle of the "9" scale, adjust the C-LIM control until the center of the all-white screen measures in the middle of the "9" scale on the light meter.

**Note** If you cannot attain a "9" reading on the light meter using the C-LIM control, turn up (clockwise) the three GAIN controls 1/4 turn and repeat step 22.

23. If the screen again has a predominant color, repeat steps 15 to 22.

**Note** The white balance is properly adjusted if:

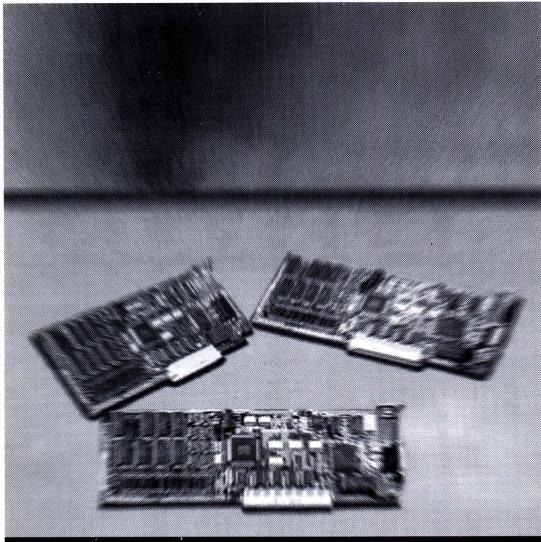
- There is no predominant color in the gray bars.
- The center of the all-white screen measures at the middle of the "9" scale on the light meter.
- The rightmost three bars are, respectively, black (furthest-right bar), barely visible, and dark gray.

24. Switch the monitor power off, and replace the rear cover, the CRT access cover, and the CRT/video board access cover.





## Macintosh Video Cards

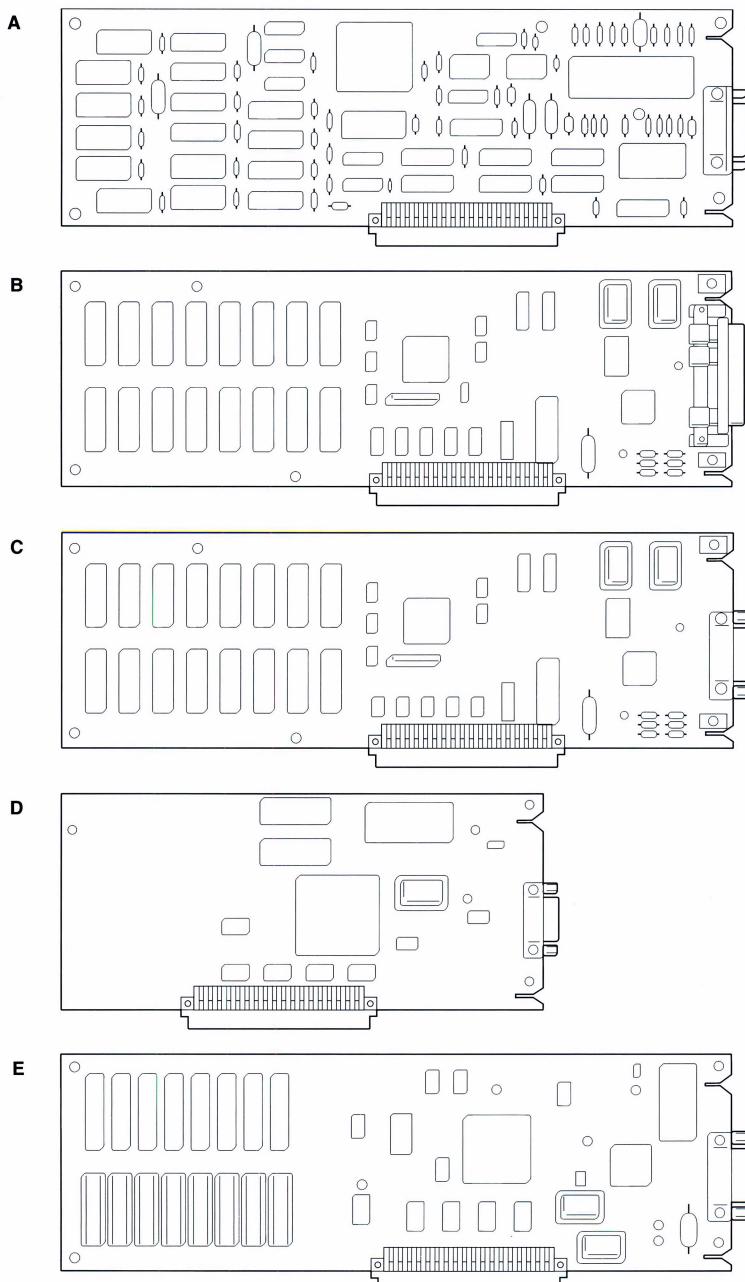


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Video Output Table	182
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## Illustrated Parts List



**Figure 1 Macintosh II Video Cards**

---

### **Macintosh II Video Card (Figure 1A)**

Macintosh II Video Card, 4-bit .....	661-0376
Video RAM IC, 150 ns .....	334-0024

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### **Macintosh II Two-Page Monochrome Video Card (Figure 1B)**

Macintosh II Two-Page Monochrome Video Card .....	661-0456
Video RAM IC, 150 ns .....	334-0024

---

### **Macintosh II Portrait Video Card (Figure 1C)**

Macintosh II Portrait Display Video Card, DA-15 .....	661-0586
Macintosh II Portrait Display Video Card (DA-15), and	
DA-15 to DB-25 cable (replaces 661-0604, DB-25) .....	661-0587

Video RAM IC, 150 ns .....	334-0024
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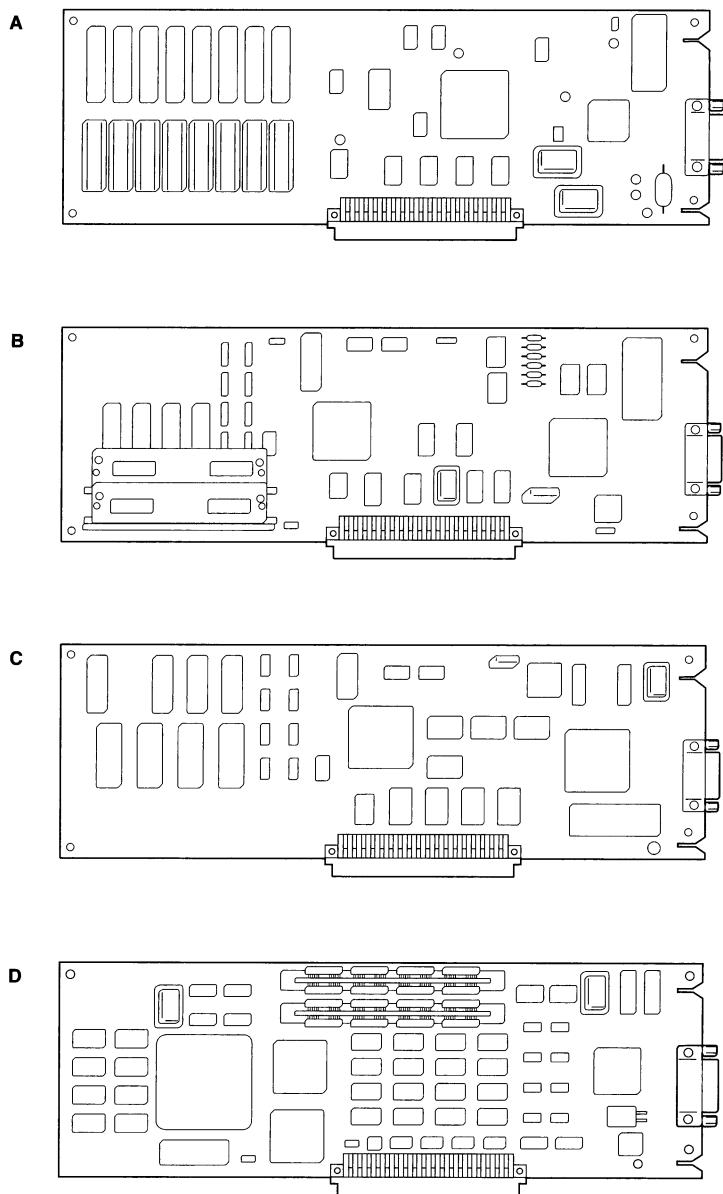
### **Macintosh II Monochrome Video Card, 1-Bit (Figure 1D)**

Macintosh II Monochrome Video Card, 1-bit .....	661-0518
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### **Macintosh II High-Resolution Display Video Card (Figure 1E)**

Macintosh II High-Resolution Display Video Card, 4-bit .....	661-0493
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**Figure 2** Macintosh II Video Cards

## Card Compatibility and Video Output Table

Use the following table to determine which cards are compatible with which monitors and CPUs, and to determine the output that you can obtain with each configuration.

**Built-In and NuBus Video Compatibility and Output**

CPU with On-Board Video	High-Res Monochrome Monitor (12")	12" Monochrome Display	Macintosh 12" RGB Display	AppleColor High-Res RGB Monitor (13")	Macintosh Color Display (13")	Apple Performa Display/Plus	Macintosh 16" Color Display	Macintosh Portrait Display	Macintosh 21" Color Display	Apple 2-Page Monochrome Monitor (21")
<b>Macintosh LC, LCII, Performa 400</b> On-board video only With 512 VRAM SIMM	16 grays 256 grays	16 grays 256 grays	256 colors 32,768 colors	16 colors 256 colors	16 colors 256 colors	16 colors 256 colors	N/A N/A	N/A N/A	N/A N/A	N/A N/A
<b>Macintosh IIsi</b> On-board video only	256 grays	256 grays	256 colors	256 colors	256 colors	N/A	N/A	16 grays	N/A	N/A
<b>Macintosh IIvi, IIvx, and Performa 600</b> On-board video only (2-256K SIMMs) With Mac VRAM Exp. Kit (2-512K SIMMs)	256 grays 256 grays	256 grays 256 grays	32,768 colors 32,768 colors	256 colors 32,768 colors	256 colors 32,768 colors	256 colors 32,768 colors	N/A N/A	N/A N/A	N/A N/A	N/A N/A
<b>Macintosh IIci</b> On-board video only	256 grays	256 grays	256 colors	256 colors	256 colors	N/A	N/A	16 grays	N/A	N/A
<b>Macintosh Quadra 700</b> On-board video only With Mac VRAM Exp. Kit (2-256K SIMMs) With Mac VRAM Exp. Kit (6-256K SIMMs)	256 grays 256 grays 256 grays	256 grays 256 grays 256 grays	256 colors 16.7 mill. colors 16.7 mill. colors	256 colors 256 colors 16.7 mill. colors	256 colors 256 colors 16.7 mill. colors	N/A	256 colors 256 colors 16.7 mill. colors	16 grays 256 grays 256 grays	16 colors 256 colors 256 colors	16 grays 256 grays 256 grays
<b>Macintosh Quadra 900 and 950</b> On-board video only With Mac VRAM Exp. Kit (4-256K SIMM)	256 grays 256 grays	256 grays 256 grays	16.7 mill. colors 16.7 mill. colors	256 colors 16.7 mill. colors	256 colors 16.7 mill. colors	N/A	256 colors 16.7 mill. colors	256 grays 256 grays	256 colors 256 colors	256 grays 256 grays
<b>Macintosh PowerBook 160, 180, and Duo 210 and 230 MiniDock</b> On-board video only	256 grays	256 grays	256 colors	256 colors	256 colors	N/A	256 colors	16 grays	N/A	N/A
<b>Mac PowerBook 210, 230 Duo Dock</b> On-board video only With 512 VRAM SIMM	256 grays 256 grays	256 grays 256 grays	256 colors 32,768 colors	256 colors 32,768 colors	256 colors 32,768 colors	N/A	256 colors 256 colors	16 grays 256 grays	N/A N/A	N/A N/A
<b>CPUs with Video Cards</b> With Macintosh II Video Card With Macintosh II 2-Page Mono Card With Macintosh II Portrait Video Card With Macintosh II Mono Video Card With Macintosh II High-Res Card With Macintosh II Ext High-Res Card With Macintosh Display Card 4*8 With Macintosh Display Card 8*24 With Macintosh Display Card 8*24GC	16 grays N/A N/A N/A 2 grays 16 grays 256 grays 256 grays 256 grays 256 grays 256 grays 256 grays	16 grays N/A N/A N/A 2 grays 16 grays 256 grays 256 grays 256 grays 16.7 mill. colors 16.7 mill. colors 16.7 mill. colors	N/A N/A N/A N/A N/A N/A N/A N/A N/A	16 colors N/A N/A N/A 16 colors 16 colors 256 colors 256 colors 256 colors 16.7 mill. colors 16.7 mill. colors 16.7 mill. colors	16 colors N/A N/A N/A 16 colors 16 colors 256 colors 256 colors 256 colors 16.7 mill. colors 16.7 mill. colors 16.7 mill. colors	16 colors N/A N/A N/A N/A N/A N/A N/A N/A	N/A N/A N/A N/A N/A N/A N/A N/A N/A	N/A N/A 4 grays N/A N/A N/A N/A N/A 16 grays 256 grays 32,768 colors**	N/A N/A N/A N/A N/A N/A N/A N/A 16 colors 256 colors 256 colors	N/A N/A N/A N/A N/A N/A N/A N/A 16 grays 256 grays 256 grays

\* Available with rev. B ROM.

\*\* Available with rev. B card.

---

### **Macintosh II Extended High-Resolution Display Video Card (Figure 2A)**

Macintosh II Extended High-Resolution Display  
Video Card, 8-bit (replaces 661-0492).....661-0533

---

### **Macintosh Display Card 4/8 (Figure 2B)**

Macintosh II Display Card 4/8, rev. B  
(replaces 661-0607) .....661-0677  
VRAM SIMM, 256K, 100 ns (Macintosh Display  
Card 4/8).....661-0609  
Display card ROM upgrade .....076-0548

---

### **Macintosh Display Card 8/24 (Figure 2C)**

Macintosh II Display Card 8/24, rev. B  
(replaces 661-0608) .....661-0678  
Display card ROM upgrade .....076-0548

---

### **Macintosh Display Card 8/24•GC (Figure 2D)**

Macintosh II Display Card 8/24•GC, rev. B  
(replaces 661-0606) .....661-1642  
DRAM SIMM 1 MB, 100 ns .....661-0610  
Display card ROM upgrade .....076-1019

---

### **Macintosh II Extended High-Resolution Display Video Card (Figure 2A)**

Macintosh II Extended High-Resolution Display Video Card, 8-bit (replaces 661-0492).....661-0533

---

### **Macintosh Display Card 4/8 (Figure 2B)**

Macintosh II Display Card 4/8, rev. B  
(replaces 661-0607) .....661-0677  
VRAM SIMM, 256K, 100 ns (Macintosh Display Card 4/8) .....661-0609  
Display card ROM upgrade .....076-0548

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### **Macintosh Display Card 8/24 (Figure 2C)**

Macintosh II Display Card 8/24, rev. B  
(replaces 661-0608) .....661-0678  
Display card ROM upgrade .....076-0548

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### **Macintosh Display Card 8/24•GC (Figure 2D)**

Macintosh II Display Card 8/24•GC, rev. B  
(replaces 661-0606) .....661-1642  
DRAM SIMM 1 MB, 100 ns .....661-0610  
Display card ROM upgrade .....076-1019

ole with which monitors and CPUs, and to determine the output that you can

## **o Compatibility and Output**

<b>Color s RGB (13")</b>	<b>Macintosh Color Display (13")</b>	<b>Apple Performa Display/Plus</b>	<b>Macintosh 16" Color Display</b>	<b>Macintosh Portrait Display</b>	<b>Macintosh 21" Color Display</b>	<b>Apple 2-Page Monochrome Monitor (21")</b>
;	16 colors 256 colors	16 colors 256 colors	N/A N/A	N/A N/A	N/A N/A	N/A N/A
rs	256 colors	N/A	N/A	16 grays	N/A	N/A
rs colors	256 colors 32,768 colors	256 colors 32,768 colors	N/A N/A	N/A N/A	N/A N/A	N/A N/A
irs	256 colors	N/A	N/A	16 grays	N/A	N/A
rs rs colors	256 colors 256 colors 16.7 mill. colors	N/A	256 colors 256 colors 16.7 mill. colors	16 grays 256 grays 256 grays	16 colors 256 colors 256 colors	16 grays 256 grays 256 grays
rs . colors	256 colors 16.7 mill. colors	N/A	256 colors 16.7 mill. colors	256 grays 256 grays	256 colors 256 colors	256 grays 256 grays
rs	256 colors	N/A	256 colors	16 grays	N/A	N/A
rs colors	256 colors 32,768 colors	N/A	256 colors 256 colors	16 grays 256 grays	N/A N/A	N/A N/A
;	16 colors N/A N/A N/A	16 colors N/A N/A N/A	N/A N/A N/A N/A	N/A N/A 4 grays N/A	N/A N/A N/A N/A	N/A 4 grays N/A N/A
;	16 colors 256 colors 256 colors . colors	16 colors 256 colors 256 colors 16.7 mill. colors	N/A N/A 256 colors*	N/A N/A 16 grays	N/A N/A 16 colors	N/A N/A 16 grays
rs	256 colors 16.7 mill. colors	16.7 mill. colors	256 colors* 32,768 colors**	256 grays 256 grays	256 colors 256 colors	256 grays 256 grays

---

## Troubleshooting

If a video card is not functioning correctly, a number of video symptoms may occur, such as a totally dark screen or a bright screen with no recognizable video display. Use the following checklist as a general troubleshooting guide.

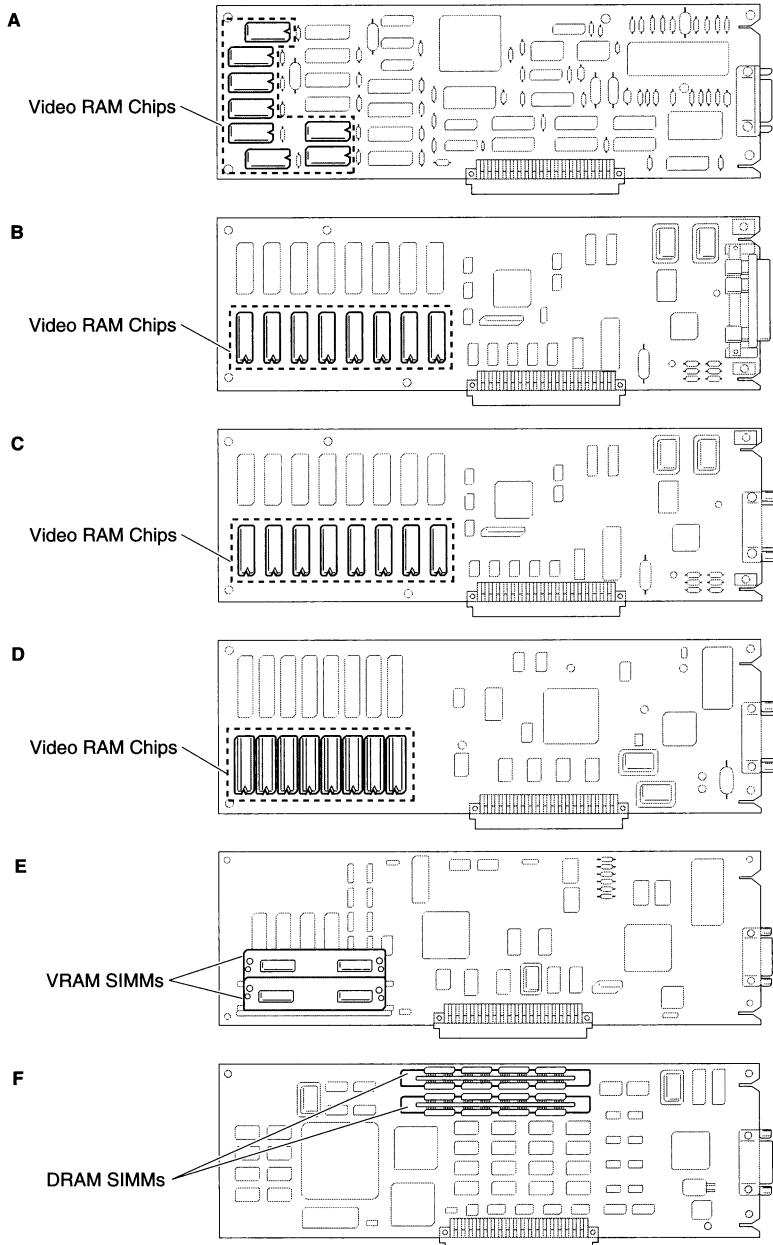
- Reseat the card; it may be inserted incorrectly.
- Check the video cable connections.
- Reseat the video or dynamic RAM on the video card.
- Run *MacTest Pro*.
- Replace the video card.

**Important** When you run *MacTest Pro*, make certain that you are using the Monitors test module AND either the Video Cards test module or the CPU test module.

---

## Video Upgrades

---



**Figure 3 Macintosh II Video Card Upgrades**

---

Use the Video Card Upgrade Information table to determine the current and upgraded capabilities of the video card. Then follow the procedure to upgrade the video card.

Video Card Upgrades			
Video Card	Fig. Ref.	Upgrade From:	Upgrade To:
Mac II Video Card	3A	4 bits per pixel 16 colors/grays	8 bits per pixel 256 colors/grays
Mac II Two-Page Mono. Video Card	3B	2 bits per pixel 4 grays	4 bits per pixel 16 grays
Mac II Portrait Video Card	3C	2 bits per pixel 4 grays	4 bits per pixel 16 grays
Mac II High-Res Display Video Card	3D	4 bits per pixel 16 colors/grays	8 bits per pixel 256 colors/grays
Mac Display Card 4/8	3E	8 bits per pixel 256 colors/grays	24 bits per pixel 16.7 million colors 256 grays
Mac Display Card 8/24•GC	3F	No DRAM	2 MB DRAM

#### **Materials Required**

Grounded workbench and wriststrap

*MacTest Pro* (Monitor Test Patterns module and either the Video Cards test module or the appropriate CPU test module)

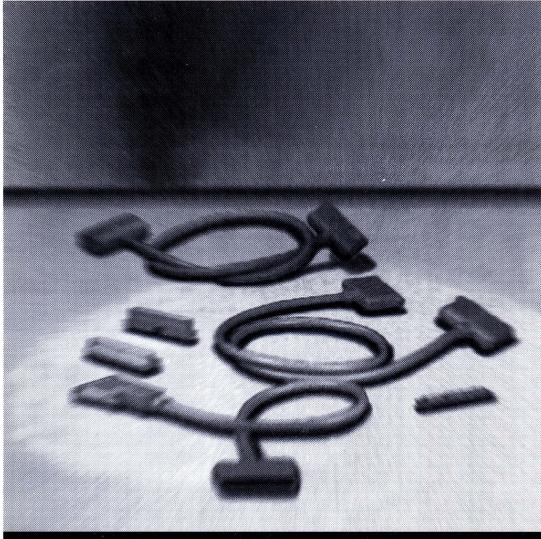
Video card expansion kit

Appropriate video card

1. FIGURE 3. Install the video RAM chips/SIMMs in the designated location.
2. Reinstall the video card, and connect the monitor.
3. Start the *MacTest Pro* diagnostic.
4. Open the Control Panel and click on the monitor icon. Set the monitor to **Grays** and **16**.
5. If there are no problems with the video RAM upgrade, the diagnostic will indicate that all tests have passed.

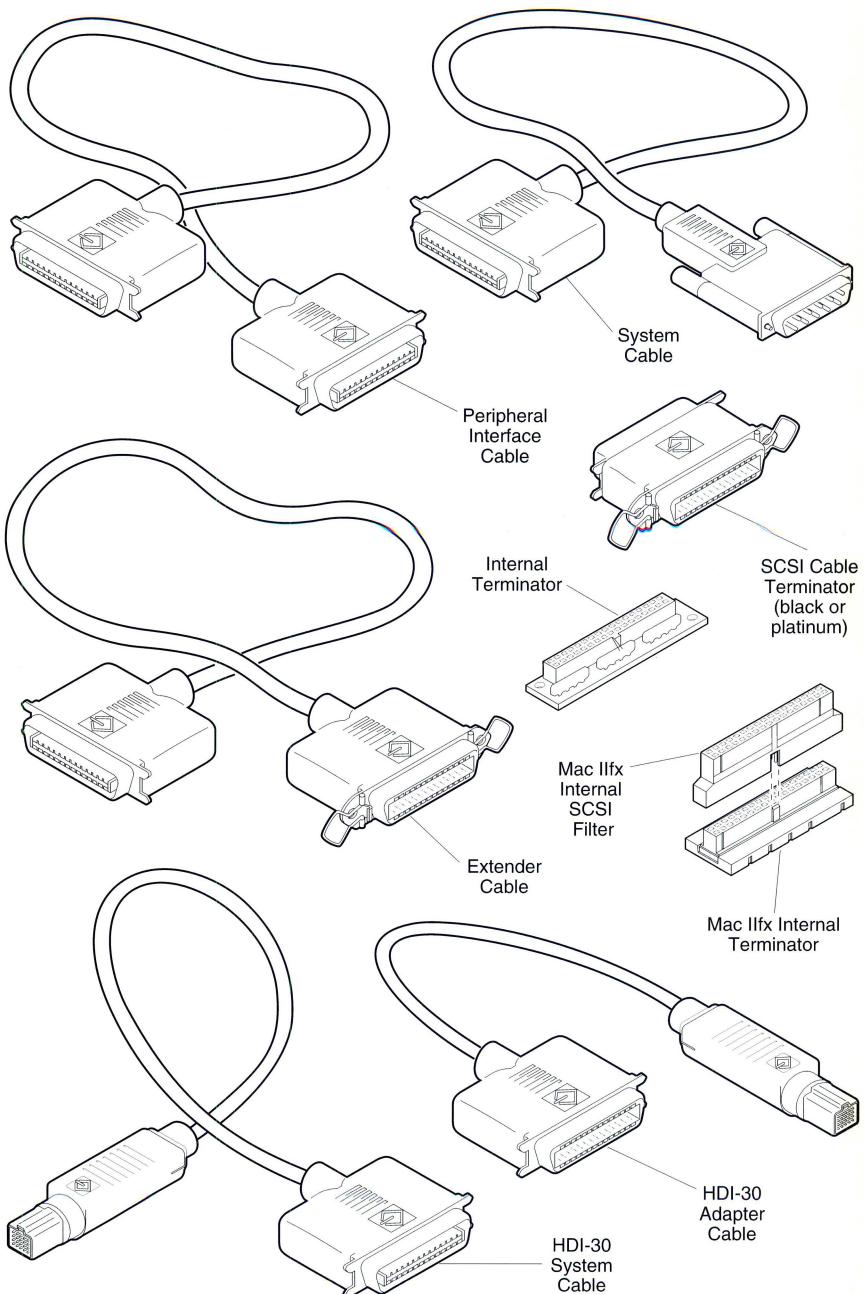


## General SCSI Information



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---

**Illustrated Parts List**

**Figure 1 SCSI Cabling, Terminators, and Filter**

---

Cables	
Extender cable .....	658-8033
HDI-30 adapter cable .....	590-0718
HDI-30 system cable .....	590-0717
Peripheral interface cable.....	658-8034
System cable .....	658-8031
External Terminators	
SCSI cable terminator, platinum.....	658-8032
SCSI cable terminator II, black, Mac IIfx .....	590-0705
Filter	
Mac IIfx internal SCSI filter.....	590-4516
Internal Terminators	
Cable, SCSI with terminator, Mac Quadra 900/950 (not shown) .....	590-0528
Internal terminator, Classic series, LC series, II, IIfx, IIsi, IIvi, IIvx, Performa series, Quadra 700 .....	630-0408
Internal terminator, Mac IIfx .....	590-4515

### A Brief Overview of SCSI

Small Computer Systems Interface, SCSI, is a specification of mechanical, electrical, and functional standards for connecting small computers to intelligent peripherals such as hard disks, printers, scanners, and CD-ROM devices. SCSI cabling systems, or chains, are intended for use with individual workstations. To function properly, SCSI chains require (at minimum) a unique SCSI ID for each device, termination power, and proper termination.

The SCSI chain must have a designated beginning and end. Because the SCSI cabling system recognizes SCSI terminators as the ends of the chain, **it is very important to use terminators at both ends of the SCSI chain and nowhere else**. There are three types of SCSI terminators:

1. Termination resistors or a jumper, connected to the device controller board
2. Internal terminators, connected to the logic board SCSI connector inside of computers that are sold without hard drives
3. External terminators, connected between the external SCSI connector of the SCSI device and the external SCSI cable (connecting to the next SCSI device on the chain)

Termination power directs when and how information will be transferred and keeps the SCSI signals clean. **For the chain to function, one device on the SCSI chain must supply termination power.**

The SCSI identification number, or SCSI ID, represents the priority of each device on the the SCSI chain. **Each device MUST have a unique ID.** Access time is so rapid that the priority assigned a device is not usually important—as long as the priority is unique. Apple's ID numbers range between 0 (factory assigned to the computer's internal drive) and 7 (factory assigned to the CPU); this leaves 1 through 6 for you to assign to the other devices on the SCSI chain. To set the SCSI ID, use the SCSI select switch on external drives and the Macintosh Quadra™ 900/950, or jumper the proper SCSI select pins on internal drives (see the Hard Drives chapter).

---

## Quick Reference Information

Use the following information to set up and troubleshoot SCSI cabling systems.

### Internal Termination Configuration of Apple Products

- Apple computers are terminated by an internal hard drive, an internal terminator, or the logic board.
- Apple external hard drives are not terminated.
- Apple external SCSI devices are not terminated.
- All Apple replacement drives have termination resistors /jumper in place. Remove these resistors before installing them in the Quadra 900/950 or any external hard drive.

### Terminators and Filters

- External Termination
  - Mac IIfx: SCSI cable terminator II, black (590-0705)
  - All other Macintosh computers and SCSI devices: SCSI cable terminator, platinum (590-0705)

**▲ Caution** **Never connect more than one SCSI cable terminator II on a SCSI chain. Connecting more than one terminator II can damage the Macintosh IIfx.**

- Internal Termination
  - You must remove all internal terminator blocks when you install a terminated hard drive in a computer.
  - Mac Classic series, LC series, II, IIx, IIsi, IIvi, IIvx, Performa™ series, Quadra 700:  
Plug-in terminator block (630-0408)
  - Macintosh IIfx: Internal terminator block (590-4515)  
Internal SCSI filter (590-4516)

Termination characteristics of the Mac IIfx are unique. The Macintosh IIfx internal SCSI filter should remain in the computer regardless of the presence of a hard drive. The filter should be located in the Macintosh IIfx as follows:

<u>Hard Drive Installed?</u>	<u>Location of Mac IIfx Internal SCSI Filter</u>
No	Between the logic board SCSI connector and the Internal terminator block
Yes	Between the hard drive 50-pin SCSI connector and the internal SCSI cable.

---

## **Termination Power Supplied In Apple Products**

- Macintosh 128, 512, Plus, Portable, and PowerBook™ computers do not supply termination power.
- All other Macintosh computers provide termination power.
- To assure correct termination power when using a 400 MB drive (661-1636) in the Mac Quadra 700, 900, and 950, use jumpers on pins 5, 7, and 8 of the J6 connector.
- Apple external SCSI devices provide termination power.

## **SCSI ID Assignments**

- Each SCSI device MUST have a unique number.
- Macintosh computer: 7 (factory set). Only one Macintosh computer can be connected to the SCSI chain.
- Apple hard drives inside of the computer: 0 (factory set).
- Macintosh IIvi, IIvx, Performa 600, and Quadra 900/950 internal devices: 0–6. In these systems, all internal and external devices must have unique numbers. Internal and external devices form one SCSI chain.
- Addressing sequence: 7, 6, 5, 4, 3, 2, 1, 0.

## **Maximum Recommended Number of SCSI Devices**

- Macintosh Portable, PowerBooks: 3–5 (including CPU)
- All other Macintosh computers: 7 (including CPU)

## **Powering On the SCSI Chain**

- Power on external SCSI devices before the computer.
- Power on the device that supplies termination power to the SCSI chain even if you aren't using the device.
- If a SCSI device does not supply termination power and you are not using it, leave the device turned off.

**▲ Caution When troubleshooting, power off the entire SCSI chain before connecting or disconnecting cables and devices. If left on while you are reconfiguring the chain, the electrical current can damage the equipment.**

## **Length of the SCSI Chain**

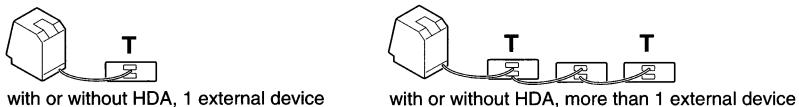
- Maximum length of chain: 20 ft. (15 ft. recommended)
- Maximum length between SCSI devices: 6 ft.

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## Terminating the SCSI Chain

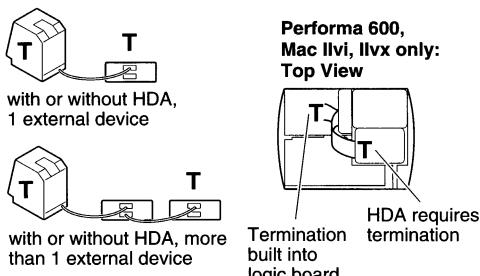
Some Macintosh computers are not internally terminated. Terminate the SCSI chain according to Figure 2. HDA stands for hard drive assembly.

### Mac, Mac Plus, Mac Portable, Mac SE, SE/30, Mac II, IIx, IIcx, IIci

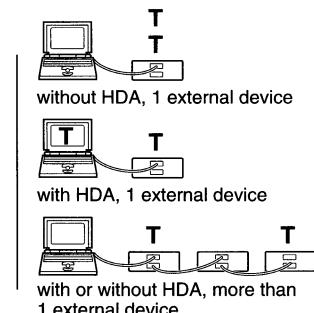


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### Mac Classic, Classic II, LC, LC II, Performa 200, 400, 600, IIvi, IIvx, IIsi, IIfx, Quadra 700, Duo Dock

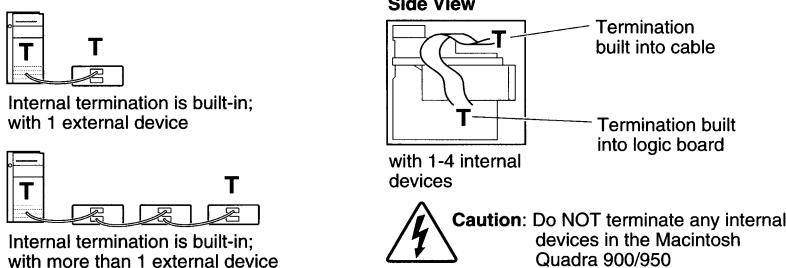


### PowerBook 100, 140, 145, 160, 170, 180, and Duo 210, 230



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### Macintosh Quadra 900/950



When located in a computer, the **T** indicates the device is terminated. When located above an external device, the **T** indicates external terminator locations.

**Figure 2 Terminating the SCSI Chain**

### Troubleshooting Checklist

Use the information in this checklist to help you troubleshoot a SCSI chain.

**▲ Caution Power off the entire SCSI chain before connecting or disconnecting cables and devices. If left on while you are reconfiguring the chain, the electrical current can damage the equipment.**

- Verify that all external SCSI cable connections are secure (connecting screws and clamps are fastened tightly).
- Verify that the distance between each SCSI device does not exceed 6 feet and that the entire SCSI chain length does not exceed 15 feet. If the chain consists of a computer and only one device, the distance between the two SCSI devices can be 15 feet. (However, Apple does not recommend using long cables with the Macintosh Plus, Portable, or PowerBook computers.)
- Check that all devices on the SCSI chain are powered on.
- Check vendor literature to verify cable impedance match among all of the cables in the SCSI chain. The impedance of the cables in the chain should be the same to assure a properly functioning bus.
- Check that all devices on the SCSI chain have the correct software for the Macintosh environment and for the individual device.
- Check that each device on the SCSI chain has a unique SCSI ID. If a device is not recognized on the SCSI chain, changing the device's priority (by changing the SCSI ID) can help the chain to find the device. If the device is assigned a high priority (6 or 5) and the device is slow to start, the chain may be looking for the device before the device can respond. Setting the device's SCSI ID to a lower priority (1 or 2) will give the device more time to ready itself for reply.
- Check that the SCSI chain is properly terminated. This is especially important if third-party devices are attached to the chain. When checking third-party devices, look for the existence and type of internal termination resistors/jumpers. Any device that is terminated has to be at the end of the SCSI chain and the type of terminator must be compatible with the rest of the chain.
- Check the owner's manuals to verify that the devices on the SCSI chain are compatible.

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- Check vendor literature to verify that a device on the SCSI chain supplies termination power.
- Using Apple TechStep™ , check that the termination power is steady.
- Remove all extension cabling from the SCSI chain before you start testing the chain.
- Test all SCSI cables and terminators by connecting them to a known-good SCSI chain (a computer and one SCSI device).
- Check the owner's manuals (and test) to verify that the order in which the devices are arranged on the SCSI chain is suitable for all devices.
- If one device is problematic, remove that device from the SCSI chain first. Test the device with a known-good computer, then test the chain without the device connected. If both the device and the SCSI chain test well separately, there is probably a compatibility problem.
- Remove one device at a time from the SCSI chain and see if the chain's performance changes.
- As you remove devices from the chain, remember to remove the device on the end of the SCSI chain last. If you remove the end device before other devices are removed, the chain will not be terminated and it will be impossible for you to isolate the problem.

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## Most Common SCSI Chain Problems

Problems with SCSI cabling systems can arise from a number of causes. The following causes are the most common:

- No device on the SCSI chain supplies termination power
- Improper termination
- Distance between each SCSI device is too great or the entire SCSI chain is too long
- Improper software or software incompatibility
- Two or more devices with the same SCSI ID
- Cable impedance doesn't match
- Device-to-chain compatibility problems
- Nonfunctional cable or terminator

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## ESD Prevention

Electrostatic discharge (ESD) can irreparably damage the sensitive chips and printed circuitry of electronic components. Plastic utensils, foam cups, polyester clothing, and even the ungrounded touch of your hand carry sufficient electrostatic charges to damage electronic components. Follow the ESD prevention rules and procedure below to prevent ESD damage.

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### ESD Prevention Rules

1. Before working on a device containing a printed circuit, ground yourself and your equipment. Use a grounded conductive workbench mat and a grounding wriststrap, and ground your equipment to the mat.

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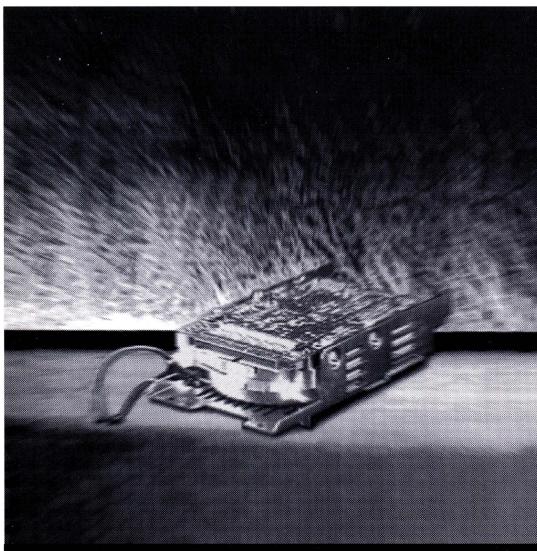
#### ▲ Warning

#### **Make certain that you are NOT grounded when:**

- You work on plugged-in equipment
- You discharge a cathode-ray tube (CRT)
- You work on an unplugged CRT that has not been discharged

2. Do not touch anyone who is working on integrated circuits. You could "zap" the equipment through the technician—even though the technician is grounded.
3. Use static-shielding bags for boards and chips during storage, transportation, and handling. Leave all Apple service components in the ESD-safe packaging until you need them.
4. Handle all ICs by the body, not the leads. Also, do not touch the edge connectors or exposed circuitry on boards or cards.
5. Do not wear polyester clothing or bring plastic, vinyl, or Styrofoam® into the work environment. The electrostatic field around these nonconductors cannot be removed.
6. Never place components on any metal surface. Use antistatic, conductive, or special foam rubber mats.
7. If possible, keep the humidity in the service area between 70% and 90%, and use an ion generator. Charge levels are reduced (but not eliminated) in high-humidity environments and in areas with ion generators.
8. If an ESD pad/workstation is not available, touch the bare metal on the power supply to discharge electrostatic charges.

## Hard Drives



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Illustrated Parts List

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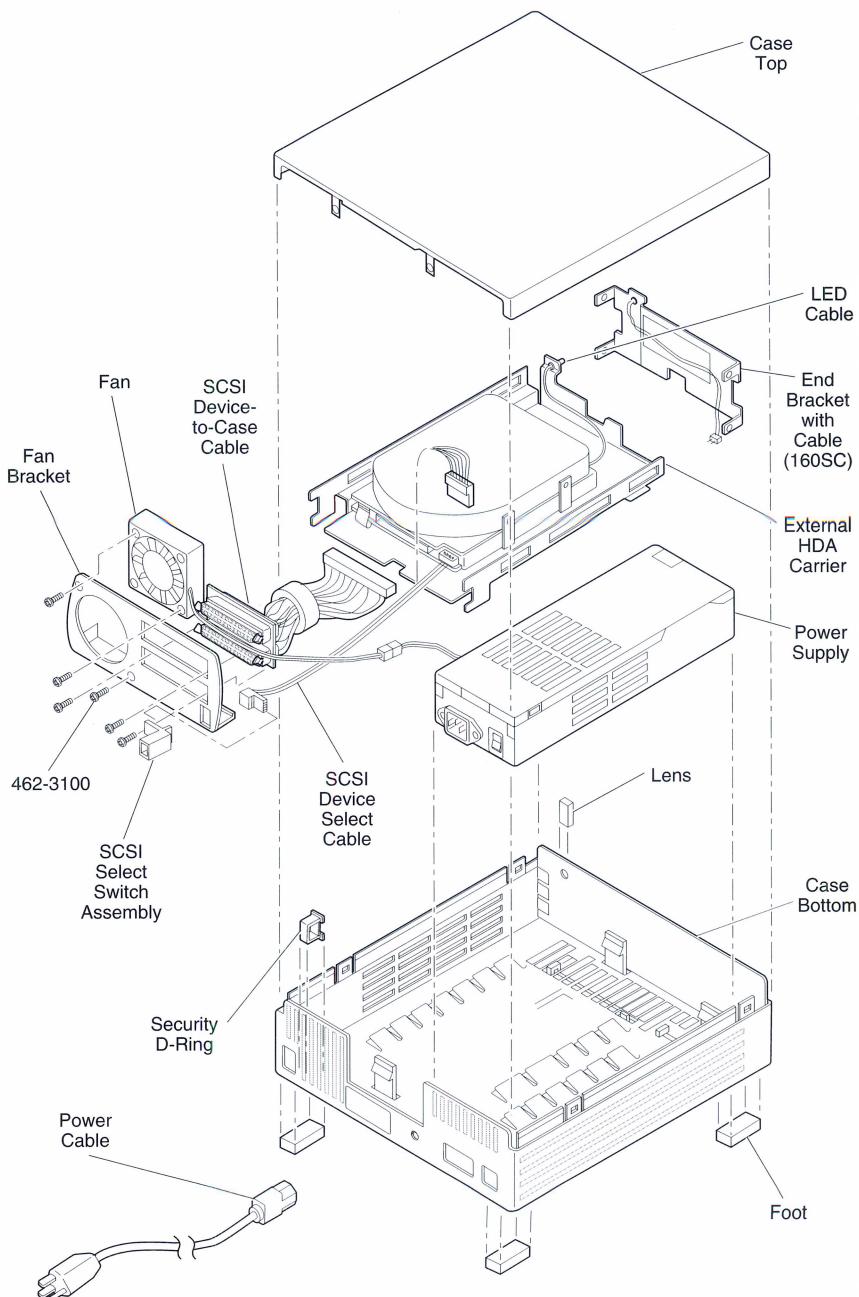


Figure 1 External Hard Drive Exploded View

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## **External Hard Drive Parts**

### Brackets

Assembled end bracket with LED cable, 160SC (replaces 590-4038) .....	076-0380
Screw, M3 x .5 x 6.....	462-3100
SCSI device fan bracket.....	805-0375

### Cables

LED cable .....	590-0237
LED cable (used with drive 661-0584) .....	590-0527
Power cable, external, beige .....	590-0260
Power cable, external, smoke.....	590-0380
Security D-ring, beige.....	815-0975
Security D-ring, platinum .....	815-0985
SCSI device-to-case cable.....	590-0235
SCSI device-to-case cable, 160SC .....	590-4037
SCSI select cable .....	590-0238
SCSI select switch assembly.....	705-0045

### Case parts

Case bottom assembly 20SC, beige .....	630-5257
Case bottom assembly 20SC, platinum .....	630-5287
Case bottom assembly 40SC .....	630-5335
Case bottom assembly 80SC .....	630-5337
Case bottom assembly 160SC .....	630-5647
Case top assembly, beige.....	630-5258
Case top assembly, platinum .....	630-5288
Case top assembly, 160SC, platinum.....	630-5802
Foot, platinum .....	865-0024
Lens .....	815-0974

### External hard drive carriers

Carrier, external, 3.5/5.25.....	805-0376
Carrier, external, 5.25, 160SC.....	805-5081
Screw, 6-32 x 3/16.....	408-1603

Fan.....	699-0469
Fan, 160SC .....	699-5017
Power supply.....	661-0343
PROM TA.2 01 (for HD 40/80SC upgrade only).....	341-0768
Service packaging.....	602-0148

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## **Common Parts for Hard Drive Products**

20 MB hard drive mechanisms	
20 MB hard drive 3.5"	661-0302
20 MB hard drive 3.5"	661-0342
20 MB hard drive 3.5"	661-0373
20 MB hard drive 3.5" (replaced by 661-1629)	661-0612
20 MB hard drive 2.5", 17 mm	661-1622
40 MB hard drive mechanisms	
40 MB hard drive 5.25"	661-0391
40 MB hard drive 3.5" (replaced by 661-1629)	661-0464
40 MB hard drive 3.5", 1"	661-0540
40 MB hard drive 3.5", 1"	661-0614
40 MB hard drive 3.5", 1"	661-0771
40 MB hard drive 3.5", (stand. and 1")	661-1629
40 MB hard drive 2.5", 19 mm	661-1630
40 MB hard drive 2.5", 16 mm	661-1632
40 MB hard drive 2.5", 13 mm	661-1633
40 MB hard drive 2.5", 19 mm	661-1644
80 MB hard drive mechanisms	
80 MB hard drive 5.25"	661-0411
80 MB hard drive 5.25" (A/UX)	661-0457
80 MB hard drive 3.5" (A/UX)	
(replaced by 661-0613)	661-0561
80 MB hard drive 3.5"	661-0600
80 MB hard drive 3.5" (A/UX)	661-0613
80 MB hard drive 3.5", 1"	661-0624
80 MB hard drive 2.5", 17 mm	661-1643
160 MB and greater hard drive mechanisms	
160 MB hard drive 5.25"	661-0584
160 MB hard drive 5.25"	661-0601
160 MB hard drive 3.5" (replaced by 661-1641)	661-0625
160 MB hard drive 5.25" (A/UX)	661-1638
160 MB hard drive 3.5" (A/UX)	661-1639
160 MB hard drive 5.25"	661-1640
160 MB hard drive 3.5"	661-1641
160 MB hard drive 3.5", 1"	661-1647
230 MB hard drive 3.5"	661-1637
400 MB hard drive 3.5"	661-1636

## Carrier Compatibility Tables

Use the carrier compatibility tables to determine compatibility among CPUs, hard drives, and hard drive carriers.

20–80 MB Carrier Compatibility with Drive and CPU														
Hard Drive P/N	Characteristics			Carriers for CPUs and External Drives										
	MB	Width	Height	External HD	Mac SE & SE/30	Classic, Classic II, Perfm. 200	Mac LC, LC II, Perfm. 400	Mac II, IIx, IIfx	Mac IIsi	Mac IIvi, IIvx, Perfm. 600	Mac IIcx, IIci	Mac Quadra 700	Mac Quadra 900/950	
661-0302	20	3.5"	standard	No Carrier										
661-0342	20	3.5" 5.25"	standard	805-0376										
661-0373	20	3.5"	standard	805-0376	805-5066 (SE only)			805-5066 (II only)						
661-0391	40	5.25"	standard	805-5081				805-5051						
661-0614 replaces 0771	40	3.5"	1"			805-0950	805-0980		805-0980					
661-1629 replaces 0612 and 0464	40	3.5"	standard	805-0376	805-5066			805-5066			805-5078			
			1"	805-0376	805-0952			805-0952			805-5078			
661-0411	80	5.25"	standard	805-5081				805-5051						
661-0457 (A/UX)	80	5.25"	standard	805-5081				805-5051						
661-0600	80	3.5"	standard	805-0376	805-5066			805-5066			805-5078	805-5078		
			1"	805-0376	805-0952			805-0952			805-5078	805-5078		
661-0613 (A/UX) replaces 0561	80	3.5"	standard	805-0376				805-5066			805-5078			
661-0624	80	3.5"	1"	805-0376		805-0950	805-0980		805-0980	922-0066 (IIvi, IIvx only)	805-5078 (IIci only)	805-5078		

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Internal hard drive carriers and related parts*	
Carrier, 5.25"	805-5051
Carrier, 3.5 & 5.25	805-5106
Carrier, 3.5" (high side-mounting holes)	805-5066
Carrier, 3.5" (low side-mounting holes)	805-0952
Carrier, 3.5"	805-0950
Carrier, 3.5"	805-0980
Carrier, 3.5"	805-5078
Carrier, 3.5"	922-0066
Stand-offs, replacement (for drive 661-1637)	860-0037
Washers, replacement (for drive 661-1637)	860-0079
Internal power cables	
Power cable, Mac Classic series, Performa 200	590-0521
Power cable, Mac LC series, Performa 400	590-0303
Power cable, Mac IIxi	591-0027
Power cable, Mac IIvi, IIvx, Performa 600	922-0051
Power cable, Mac II, IIx, IICX	590-0505
Power cable, Mac IIfx, IICX, IIci, Quad 700	590-0512
Power cable, Mac Quad 900/950	590-0517
Internal SCSI cables	
SCSI cable, Mac SE, SE/30, Classic series, Performa 200	590-0211
SCSI cable, Mac LC series, Performa 400	590-0228
SCSI cable, Mac IIxi	591-0026
SCSI cable, Mac IIvi, IIvx, Performa 600	922-0053
SCSI cable, Mac II, IIx, IIfx	590-0566
SCSI cable, Mac IICX, IIci, Quad 700	590-0609
SCSI cable, Mac Quad 900/950	590-0528
SCSI cable, PowerBook series	630-0534
LEDs for hard drives in CPUs	
LED, amber, Mac IICX, IIci	590-0506
LED, red, Mac SE, SE/30	590-0237
SCSI select cables (internal)	
SCSI select cable (for drive 661-1636)	590-0790
SCSI select cable (accommodates half-size SCSI select pins, for drive 661-1637)	590-0794
SCSI select switch, internal, Mac Quadra 900/950	705-0045
Service Packaging	
For packaging compatibility, see the Service Programs information on <i>Service Source</i> .	

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\* For carrier compatibility information, see the Carrier Compatibility tables later in this chapter.

**160–400 MB Carrier Compatibility with Drive and CPU**

Hard Drive P/N	Characteristics			Carriers for CPUs and External Drives									
	MB	Width	Height	External HD	Mac SE & SE/30	Classic, Classic II, Perfm. 200	Mac LC, LC II, Perfm. 400	Mac II, IIx, IIfx	Mac IIsi	Mac IIvi, IIvx, Perfm. 600	Mac IIcx, IIci	Mac Quadra 700	Mac Quadra 900/950
661-0584 <sup>1</sup>	160	5.25"	standard	805-5081									
661-0601 <sup>1</sup>	160	5.25"	standard					805-5051 (II, IIx only)					
661-1638 (A/UX)	160	5.25"	standard					805-5051 (II, IIx only)					
661-1640 <sup>1</sup>	160	5.25"	standard	805-0376				805-5051 (IIfx only)					
661-1639 (A/UX)	160	3.5"	standard					805-5066 (IIfx only)			805-5078 (IIci only)		
661-1641 replaces 0625	160	3.5"	standard					805-5066 (IIfx only)		922-0066 (P 600 only)	805-5078 (IIci only)	805-5078	805-5106
661-1647	160	3.5"	1"			805-0950 (CI II and P 200 only)	805-0980 (LC II and P 400 only)		805-0980				
661-1649	160	3.5"	1"	805-0376	805-0952	805-0950 (CI II and P 200 only)	805-0980 (LC II and P 400 only)	805-0952	805-0980		805-5078 (IIci only)		
661-1637 <sup>2</sup>	230	3.5"	standard							922-0066 (IIvx only)	805-5078 (IIci only)	805-5078	805-5106
661-1636 <sup>3</sup>	400	3.5"	standard							922-0066 (IIvx only)		805-5078	805-5106

1 Drives 661-0584, 661-0601, and 661-1640 are identical in appearance. Identify these drives by the vendor's part numbers (777-48226, 777-48206, 777-48240 respectively).

2 Drive 661-1637 requires four standoffs and washers to correctly attach to the carrier. Use only the SCSI select cable with part number 590-0794 for this drive. The SCSI select pins are half the size of standard SCSI select pins.

3 Drive 661-1636 arrives with a spacer that should remain on the drive. The spacer is not an orderable part.

### Carrier Compatibility with Drive and Portable CPU

Hard Drive P/N	Characteristics			Carriers for CPUs			
	MB	Width	Height	Mac Portable	Power-Book 100	Power-Book 140, 145, 170	Power-Book 160, 180, Duo 210, 230
661-1622	20	2.5"	17 mm		No Carrier	No Carrier (140, 170 only)	
661-0540	40	3.5"	1"	805-5080			
661-1630	40	2.5"	19 mm			No Carrier	No Carrier
661-1632	40	2.5"	16 mm		No Carrier		
661-1644	40	2.5"	19 mm 16 mm		No Carrier 948-0002		
661-1643	80	2.5"	17 mm			No Carrier	
661-0796	80	2.5"	17 mm				No Carrier
661-0772	120	2.5"	17 mm				No Carrier (180, Duo only)

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## Return Configuration Tables

The following tables show which cables and carriers you must return with various defective hard drives. Return the specified cables and, depending on the CPU or external drive, return the defective drive in the original CPU carrier, the replacement carrier, or no carrier at all.

Hard Drive P/N	Characteristics			Return Carrier	
	MB	Width	Height	CPU Carrier	No Carrier
661-1622	20	2.5"	17 mm		PrBk 100, 140, 170
661-0540	40	3.5"	1"	Port	
661-1630	40	2.5"	19 mm		PrBk 140, 145, 160, 170, 180, Duo 210, 230
661-1632	40	2.5"	16 mm		PrBk 100
661-1644	40	2.5"	19 mm 16 mm	PrBk 100	PrBk 100
661-1643	80	2.5"	17 mm		PrBk 140, 145, 170
661-0796	80	2.5"	17 mm		PrBk 160, 180, Duo 210, 230
661-0772	120	2.5"	17 mm		PrBk 180, Duo 210, 230

**Hard Drive Return Configuration Table**

Hard Drive P/N	Characteristics			Return Cable		Return Carrier		
	MB	Width	Height	Powr	LED	Replmnt Module Carrier	CPU Carrier	No Carrier
661-0613 (A/UX)	80	3.5"	standard	✓	✓	IICX, IICI, external	II, IIx, IIFX	
661-0624	80	3.5"	1"					CI, CI II, IICI P200, LC, LC II, P400, IISI, IIVI, IIvx, Q700, extrnl
661-0774	80	3.5"	1"					Q700
661-0584	160	5.25"	standard	✓	✓		external	
661-0601	160	5.25"	standard	✓			II, IIx	
661-1638 (A/UX)	160	5.25"	standard	✓			II, IIx	
661-1640	160	5.25"	standard	✓			IIFX	
661-0625 repl. by 1641	160	3.5"	standard					IICI, IIFX
661-1639 (A/UX)	160	3.5"	standard					IICI, IIFX
661-1641	160	3.5"	standard					P600, IICI, IIFX, Q700, Q900
661-1647	160	3.5"	1"					CI, CI II, IISI, P200, LC, LC II, P400
661-1649	160	3.5"	1"					SE, SE/30, CI, CI II, LC, LC II, P200, P400, IISI, II, IIx, IIFX, IICX, IICI, extrnl
661-1637	230	3.5"	standard					IICI, IIvx, Q700, Q900
661-1636	400	3.5"	standard					IIvx, Q700, Q900

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## Return Configuration Tables

The following tables show which cables and carriers you must return with various defective hard drives. Return the specified cables and, depending on the CPU or external drive, return the defective drive in the original CPU carrier, the replacement carrier, or no carrier at all.

**Portable Hard Drive Return Configuration Table**

Hard Drive P/N	Characteristics			Return Carrier	
	MB	Width	Height	CPU Carrier	No Carrier
661-1622	20	2.5"	17 mm		PrBk 100, 140, 170
661-0540	40	3.5"	1"	Port	
661-1630	40	2.5"	19 mm		PrBk 140, 145, 160, 170, 180, Duo 210, 230
661-1632	40	2.5"	16 mm		PrBk 100
661-1644	40	2.5"	19 mm 16 mm	PrBk 100	PrBk 100
661-1643	80	2.5"	17 mm		PrBk 140, 145, 170
661-0796	80	2.5"	17 mm		PrBk 160, 180, Duo 210, 230
661-0772	120	2.5"	17 mm		PrBk 180, Duo 210, 230

**Hard Drive Return Configuration Table**

Hard Drive P/N	Characteristics			Return Cables			Return Carrier		
	MB	Width	Height	Powr	LED	SCSI Select	Replmnt Module Carrier	CPU Carrier	No Carrier
661-0302	20	3.5"	standard						external
661-0342	20	3.5"	standard		✓	✓		external	
661-0373	20	3.5"	standard	✓	✓		external	SE, II	
661-0612 repl. by 1629	20	3.5"	standard	✓	✓		llcx, llci, external	SE, SE/30, II, llx	
661-0391	40	5.25"	standard	✓			external	II, llx, llfx	
661-0464 repl. by 1629	40	3.5"	standard	✓	✓		llcx, llci, external	SE, SE/30, II, llx	
661-0614	40	3.5"	1"					Cl, Cl II, P200, LC, LC II, P400, llsi	
661-1629	40	3.5"	standard & 1"	✓	✓		llcx, llci, external	SE, SE/30, II, llx, llfx	
661-0771 repl. by 0614	40	3.5"	1"	✓	✓				Cl, Cl II, P200, LC, LC II, P400, llsi
661-0411	80	5.25"	standard	✓			external	II, llx, llfx	
661-0457 (A/UX)	80	5.25"	standard	✓			external	II, llx, llfx	
661-0561 (A/UX) repl. by 0613	80	3.5"	standard	✓	✓		llcx, llci	II, llx, llfx	
661-0600	80	3.5"	standard & 1"	✓	✓		llcx, llci, Q700, external	SE, SE/30, II, llx, llfx	

**Hard Drive Return Configuration Table**

Hard Drive P/N	Characteristics			Return Cable		Return Carrier		
	MB	Width	Height	Pwr	LED	Replmnt Module Carrier	CPU Carrier	No Carrier
661-0613 (A/UX)	80	3.5"	standard	✓	✓	Ilcx, Ilci, external	II, IIx, Ifx	
661-0624	80	3.5"	1"					Cl, Cl II, Ilci P200, LC, LC II, P400, Ilsi, Ilvi, Ilvx, Q700, extrnl
661-0774	80	3.5"	1"					Q700
661-0584	160	5.25"	standard	✓	✓		external	
661-0601	160	5.25"	standard	✓			II, IIx	
661-1638 (A/UX)	160	5.25"	standard	✓			II, IIx	
661-1640	160	5.25"	standard	✓			Ifx	
661-0625 repl. by 1641	160	3.5"	standard					Ilci, Ifx
661-1639 (A/UX)	160	3.5"	standard					Ilci, Ifx
661-1641	160	3.5"	standard					P600, Ilci, Ifx, Q700, Q900
661-1647	160	3.5"	1"					Cl, Cl II, Ilci, P200, LC, LC II, P400
661-1649	160	3.5"	1"					SE, SE/30, Cl, Cl II, LC, LC II, P200, P400, Ilsi, II, IIx, Ifx, Ilcx, Ilci, extrnl
661-1637	230	3.5"	standard					Ilci, Ilvx, Q700, Q900
661-1636	400	3.5"	standard					Ilvx, Q700, Q900

---

## Troubleshooting

To efficiently troubleshoot hard drive problems, first perform the steps in the troubleshooting checklist, then use the flowchart in Figure 2 as a general troubleshooting guide. Instructions for using *MacTest Pro* follow the troubleshooting checklist.

---

### Troubleshooting Checklist

Most hard drive problems can be found by performing the steps in this checklist.

- Use a known-good system and software.
- **Back up the suspect drive's data as soon as possible.**
- Check that every SCSI device on the SCSI chain has a unique SCSI ID.
- Verify that the SCSI chain is properly terminated.
- Check that you are using Apple SCSI cables.
- Verify that the termination resistors are removed on external hard drives.
- Use *Disk First Aid*™.
- If the wrong icon is present or a file doesn't appear, rebuild the desktop.
- Reinstall drive software. Use *HD SC Setup* and update the driver.
- Check the system folder for problem INITs.
- Check the drive for multiple system files.
- Check the termination power with the diagnostic.

---

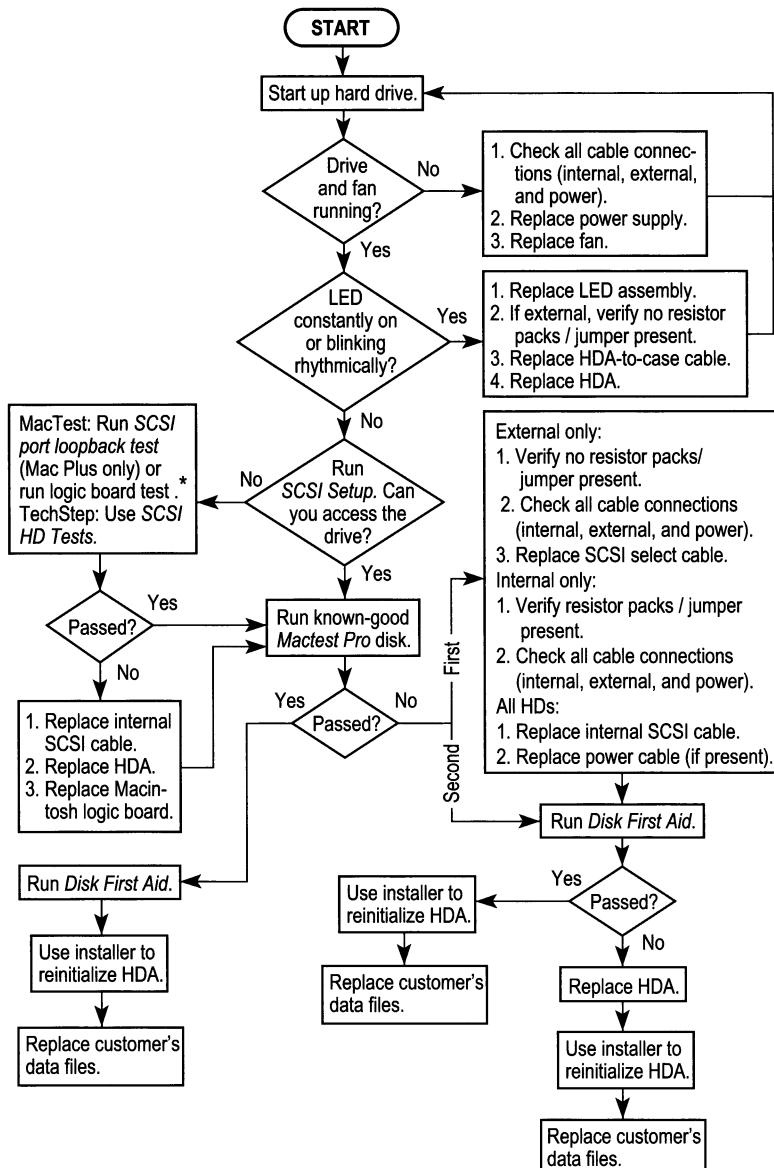
### *MacTest Pro*

When using *MacTest Pro*, always run the Bad Block Scan Test. For more thorough testing, also run the Random Seek Test.

**▲ Caution** **Running Write Test can destroy data. Run Write Test only if you suspect that the write mechanism is bad and only if the data is backed up.**

Perform steps 1 and 2 if you are testing an external drive. If you are testing an internal drive, start with step 3.

1. Connect the troubled external SCSI drive to the SCSI port on the rear of a known-good Macintosh. (Do not install a SCSI loopback card. This card inhibits the operation of the SCSI bus.)
2. Switch on the external SCSI drive.
3. Boot the diagnostic disk.
4. Select the drive test(s) that you want to run.
5. Click **OK** and then **Test**.



**Figure 2 Troubleshooting Flowchart**

\* The diagnostic does not find bad SCSI connectors on the Macintosh logic board. To rule out this possibility, perform a visual inspection of the pins and solder joints on the SCSI connectors.

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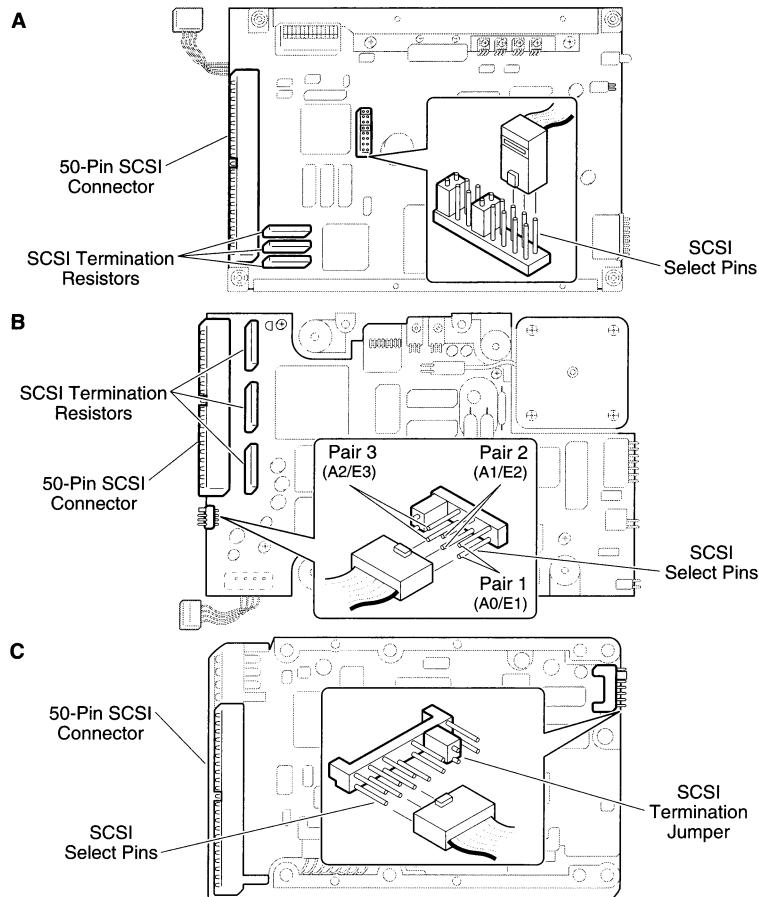
## Additional Procedures

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### SCSI Select Jumper Configurations

Each SCSI device requires a unique identity. How jumpers are configured on SCSI select pins defines the SCSI identity of the hard drive. Identify these pins using the following guidelines. Some manufacturers do not use these standards.

1. SCSI select pins are a group of at least six pins that are often located near the 50-pin SCSI connector.
2. FIGURE 3. SCSI select pins are usually located: 1) on top of the controller board, sticking up (Figure 3A), or 2) on the back of the drive, just beside the 50-pin SCSI



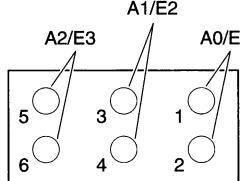
**Figure 3 Common SCSI Select Pin and Terminator Resistor Locations**

connector (Figure 3B), or 3) on the front of the drive opposite the 50-pin SCSI connector (Figure 3C).

3. FIGURE 4. When on the PCB, SCSI select pins are often labeled either A0, A1, and A2 **or** E1, E2, and E3.
4. If the pins are not labeled, use the three pairs of pins closest to the 50-pin SCSI connector. Pin pair numbers are often assigned using two standards: 1) when the pins are on top of the PCB, count toward the 50-pin connector (e.g., 1, 2, 3, 50-pin connector), 2) when the pins are on the side, count away from the 50-pin connector (50-pin connector, 3, 2, 1—see Figure 3B).

To set the SCSI ID, use jumpers on the pins as shown below.

SCSI Select Jumper Configurations			
SCSI ID	A0/E1	A1/E2	A2/E3
0	—	—	—
1	Jump	—	—
2	—	Jump	—
3	Jump	Jump	—
4	—	—	Jump
5	Jump	—	Jump
6	—	Jump	Jump
7	Jump	Jump	Jump



**Figure 4 SCSI Select Pin Labeling and Jumper Configurations**

### Termination Resistors and Jumpers

Termination resistors identify the internal hard drive as the beginning of the SCSI chain (for additional information, see the General SCSI Information chapter).

**▲ Caution Remove the termination resistors from hard drives used inside of the Quadra 900/950 and external hard drives.**

FIGURE 3A and B. Termination resistors are usually three identical resistors located near the 50-pin SCSI connector.

FIGURE 3C. On some drives a jumper on pin 6 has replaced the termination resistors. When the jumper is present, the drive is terminated.

To assure correct termination power when using a 400 MB drive (661-1636) in the Macintosh Quadra 700, 900, and 950, use jumpers on pins 5, 7, and 8 of the J6 connector.

---

## **Macintosh Hard Disk 40SC/80SC Upgrade**

Some Quantum 40 and 80 MB, 3.5-inch hard drives may experience intermittent startup problems. When the problem occurs, you will see a Macintosh disk icon with a flashing question mark or a dialogue box that says "Cannot Load Finder."

Only 40 and 80 MB drives with variation code numbers 0032, 0034, and 0058 are affected by this problem. (The variation code number is on the small bar code label in the upper-right corner of the end where the 50-pin SCSI connector is located.) This problem can be eliminated by replacing the ROM chip version 7.9 01 with the newer PROM version TA.2 01 or later.

### **Materials Required**

ROM removal tool (orange stick)  
PROM

### **Upgrade Procedure**

1. Remove the hard drive assembly.

**▲ Caution**

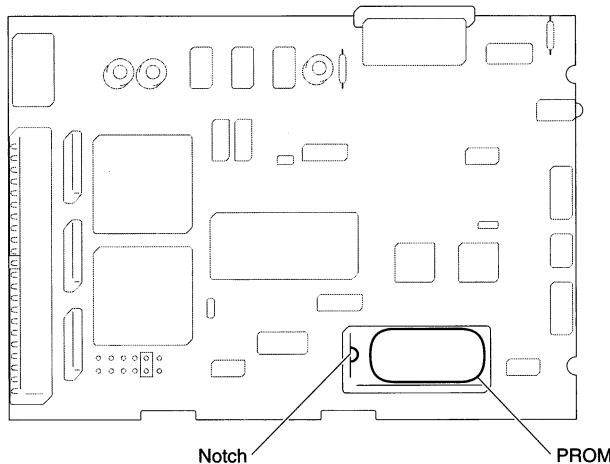
**The hard drive controller board contains electronic circuits and components that are sensitive to electrostatic discharge (ESD) damage.**

2. FIGURE 5. Compare your drive controller board to the board layout shown in the figure, and locate the 28-pin ROM chip at U201.
3. Using the ROM removal tool, gently pry the ROM from the controller board. Some ROMs have a small plastic sheet under them. Be careful not to tear this sheet when you are prying up the ROM. Return this ROM to Apple.
4. FIGURE 5. Position the new PROM over the socket so that the notch on the PROM faces the 50-pin SCSI connector.
5. Gently angle in the row of PROM pins on one side, then the other side. Push down to make sure the PROM is securely seated.
6. Install the hard drive assembly.

---

7. Using *MacTest Pro*, run the the Random Seek Test two to three times. This action lubricates the drive.

If the drive does not start or does not successfully complete the hard disk test, turn the system off for approximately 30 seconds. Turn the power on and try again. If the drive does not respond after three on-and-off power cycles, the drive has failed for reasons other than those covered here.



**Figure 5 PROM Chip Location**

---

## **Hard Drive Startup Problem**

Some hard drives exhibit startup problems after a period of use. **The hard drive must be replaced** if you do not hear the drive working during the booting sequence and the CPU does not recognize the drive. You can retrieve data off of the drive by using the following procedure.

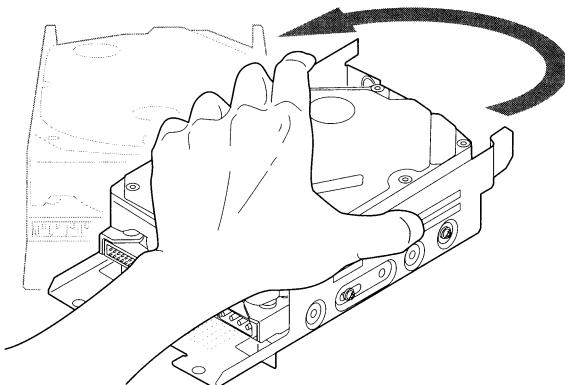
### **Materials Required**

Macintosh computer

External drive case, or sufficient blank floppy disks to copy the data from the faulty drive

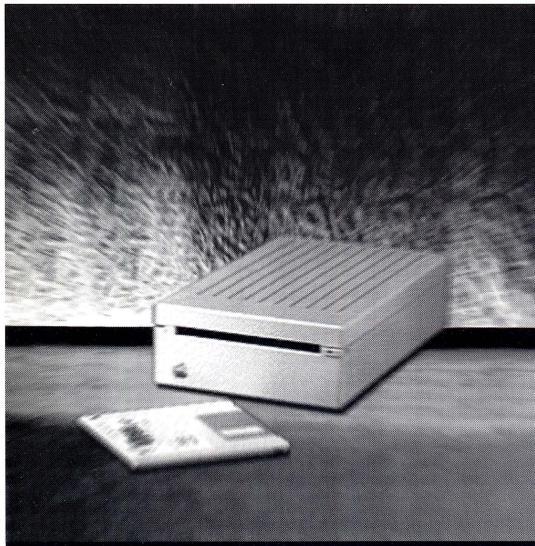
### **Data Recovery Procedure**

1. Remove the faulty hard drive.
2. FIGURE 6. Hold the hard drive tightly with the circuit board facing down (to avoid ESD damage, don't touch the circuit board). With one quick, sharp motion, rotate the drive counterclockwise. This action should allow the hard drive to start up.
3. Install the faulty drive in an extra external drive case (or back in the customer's CPU if you don't have an extra external drive case).
4. Check that the system recognizes the drive; if it does, copy the data onto another hard drive or floppy disks.



**Figure 6 Rotating a Faulty Hard Drive**

## Floppy Drives



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Illustrated Parts List

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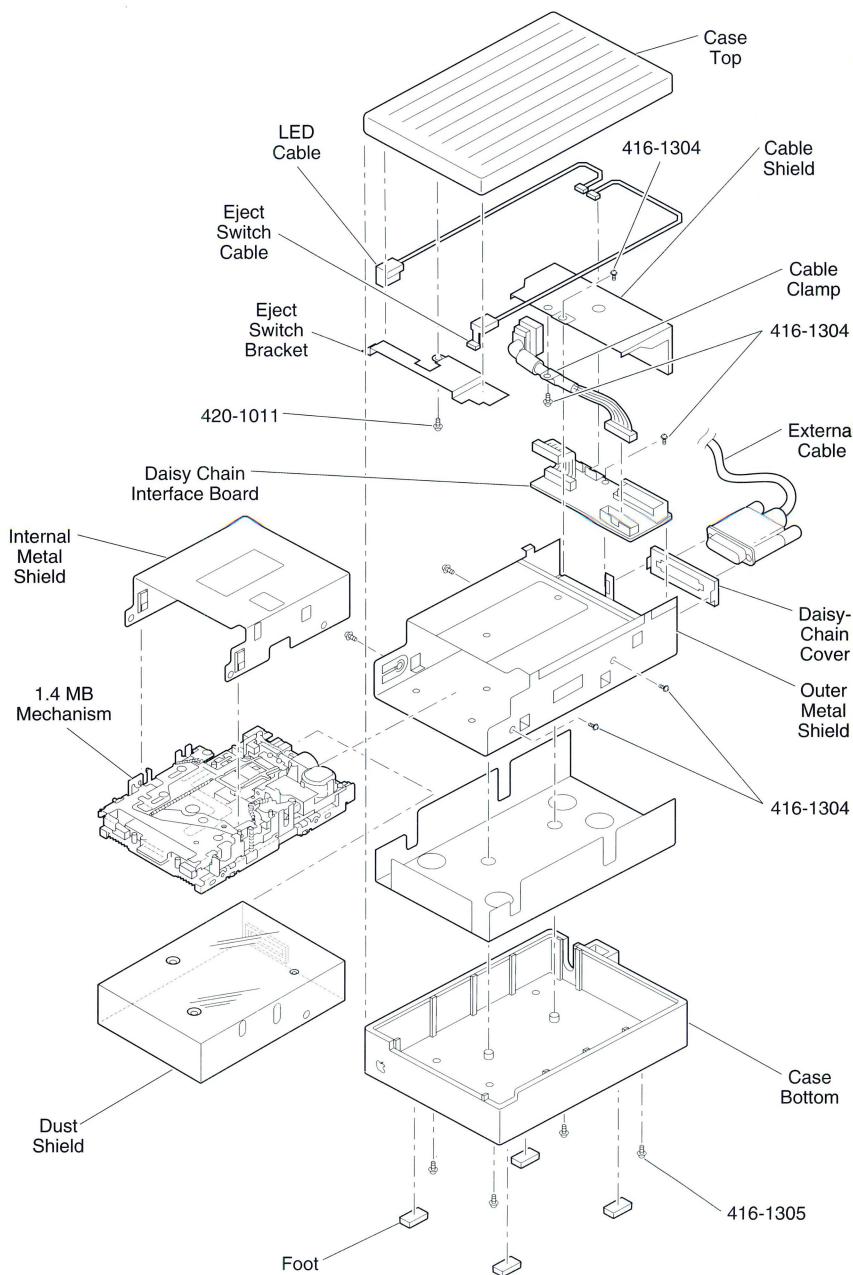


Figure 1 External Floppy Drive Exploded View

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### **Apple 3.5 External Floppy Drive and Apple SuperDrive**

Cable clamp.....	805-0378
Cable shield.....	805-0807
Case bottom, platinum, 3.5 Drive .....	815-0956
Case bottom, SuperDrive.....	603-5117
Case foot.....	865-0045
Case screw, torx .....	416-1305
Case top, platinum .....	815-0955
Daisy-chain cover.....	815-0969
Daisy-chain interface board.....	076-0234
Eject switch bracket .....	805-0811
Eject switch bracket screw.....	420-1011
Eject switch cable.....	603-5110
External cable.....	590-4360
Inner metal shield .....	805-0156
LED cable, 3.5 Drive .....	603-5109
LED cable, SuperDrive.....	603-5118
Metal shield screw.....	416-1304
Outer metal shield.....	603-5106

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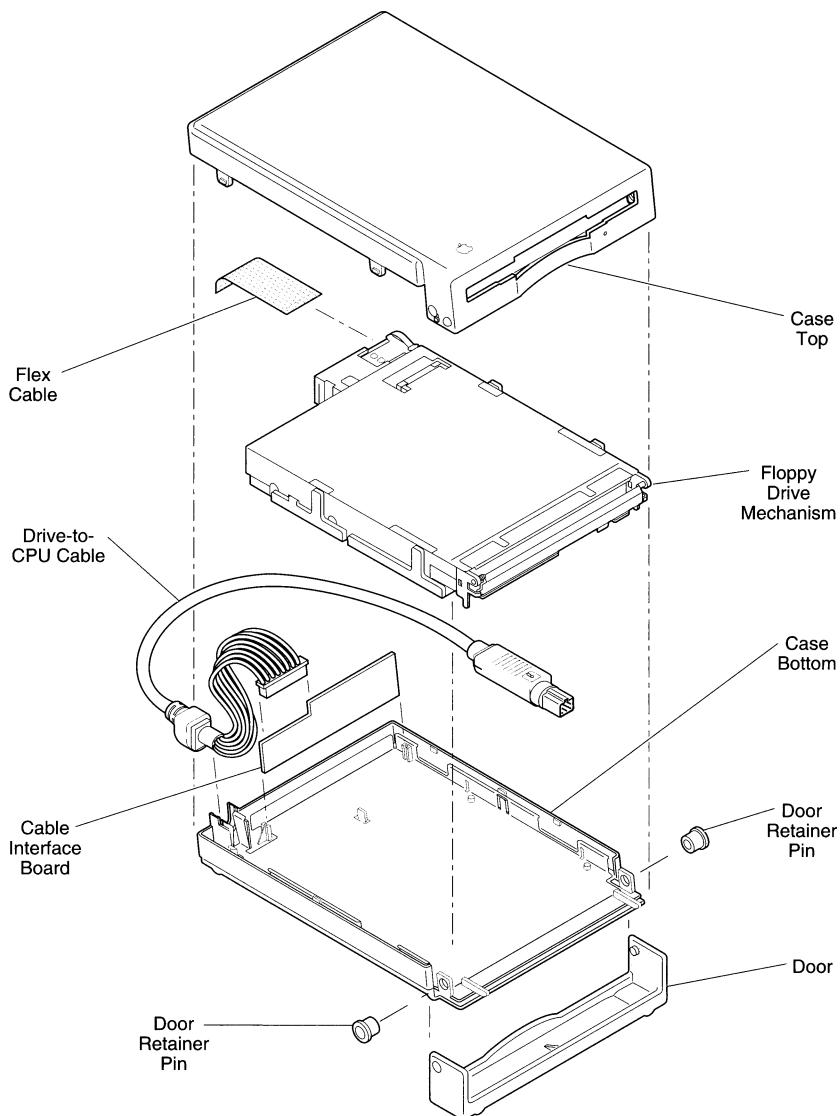
### **Macintosh 400K External Floppy Drive (not shown)**

Bezel.....	815-0798
Case bottom .....	815-0795
Case top.....	815-0796
External cable.....	590-0183
Foot.....	865-0051
Screw, M3.5 x 10.....	467-3000
Screw, Tap M2.9 x 1.06 x 13 (foot) .....	424-1001

---

### **Macintosh 800K External Floppy Drive (not shown)**

Case bottom .....	630-5181
Case screw, torx.....	416-1305
Case top.....	630-5180
External cable.....	590-0255
LED cable .....	603-5109



**Figure 2** HDI-20 External Floppy Drive Exploded View

---

## HDI-20 External Floppy Drive

Cable interface board .....	699-0479
Case bottom .....	603-5121
Case top .....	603-5120
Door .....	603-5010
Door retainer pins .....	603-5011
Drive-to-CPU cable, HDI-20 .....	590-0719
Flex cable.....	821-0655

---

## Common Parts for Floppy Drive Products

### Floppy drive mechanisms

400K mechanism .....	661-76156
800K mechanism .....	661-0345
1.4 MB floppy drive mechanism, 19 mm (replaces 661-1623) .....	661-1651
1.4 MB mechanism, Apple SuperDrive .....	661-0474

### Internal cables

Cable* .....	590-0437
Cable* .....	590-0188
Cable* .....	590-0617
Cable* .....	590-0524
Cable* .....	590-0961
Cable* .....	590-0025
Cable* .....	922-0054
Cable* .....	590-0607
Cable* .....	590-0515
Cable* .....	590-0501
Cable* .....	821-0655

### Maintenance and packaging

Carrier* .....	805-0217
Carrier* .....	948-0022
Carrier* .....	805-5050
Carrier* .....	805-5111
Carrier* .....	805-0961
Dust shield, SuperDrive (package of 5) .....	076-0439
Packing disk (for 800K mechanisms only).....	003-0003
Screw, M3 x 6 (with two washers) .....	462-3401
Service packaging, 800K/SuperDrive .....	602-0210
Service packaging, 1.4 MB floppy drive, 19 mm .....	602-0308

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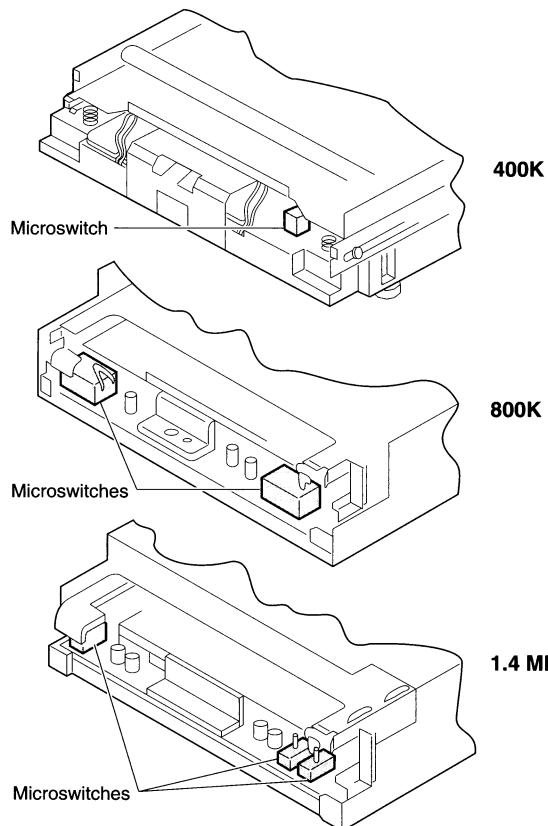
\* For information on cable, carrier, and product compatibility, see the Internal Cable and Carrier Compatibility table later in this chapter.

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## Identification

The Apple SuperDrive™ is a 1.4 MB high-density 3.5-inch drive. The SuperDrive is compatible with Apple's 400K and 800K data formats and provides data exchangeability between Apple systems (GCR data format) and MS-DOS® or OS/2® systems (MFM data formats).

FIGURE 3. To identify an unlabeled floppy drive, remove the cover of the computer or external drive and count the number of microswitches on the drive mechanism. SuperDrives have three microswitches, 800K drives have two, and 400K drives have one.



**Figure 3 Identifying Floppy Drives**

## Media and Drive Compatibility

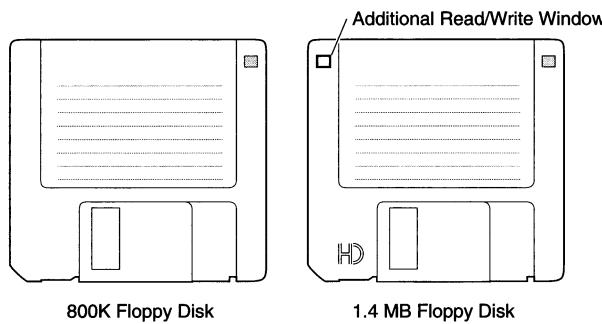
To take full advantage of the increased storage capacity of the SuperDrive, you must use high-density (HD) 3.5-inch disks. You can identify these disks by the **HD** next to the shutter and by the additional read/write window (Figure 4). Because high-density disks are structurally different from other media, media/drive compatibility problems can occur. To avoid such problems, refer to the table below.

**▲ Caution** **Apple does not recommend using high-density disks in 400K or 800K floppy drives. Data saved to high-density disks using these drives is unreliable and could be lost.**

Media and Drive Compatibility							
	Double-Sided Disks				High-Density Disks		
	400K Format	800K Format	720K Format	1.4 MB Format	800K Format	720K Format	1.4 MB Format
400K Drive	Compatible				Not recommended		
800K Drive	Compatible	Compatible			Not recommended		
1.4 MB Drive	Compatible	Compatible	Compatible				Compatible

High-density media requires the following software

- System 6.0 or later (6.0.8 or later recommended)
- *Apple File Exchange Utility* version 1.1 or greater (MS/DOS)



**Figure 4 Identifying High-Density Disks**

---

## Troubleshooting

---

### Troubleshooting Checklist

The following checklist is a general troubleshooting guide. For specific problems, use the Symptom/Cure Chart. When troubleshooting floppy drives, use known-good system software.

**▲ Caution When replacing the top covers on Macintosh II, IIx, or IIfx computers, align the top cover front latches carefully. If you hook the latch into or under the floppy drive, you can crack the floppy drive controller board.**

- Verify that the test disk you are using is good and that it is formatted correctly for the floppy drive that you are testing (i.e., 800K or 1.4 MB).
- Check all internal floppy drive cable connections.
- If the floppy drive is an external drive, check all external cable connections.
- Clean the floppy drive. If the drive is a SuperDrive, install a dust shield on the clean drive before reinstalling it. The dust shield will not fit into the Macintosh Plus, LC, LC II, Performa 400, or Portable.
- If the problem is intermittent, carefully inspect and test the internal floppy drive cable.
- If the drive shows no response to any input, replace the drive.

---

### Symptom/Cure Chart

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Problems	Solutions
Drive will not eject disk	<ol style="list-style-type: none"><li>1. Shut down the computer, press and hold the trackball or mouse button, and switch on the computer.</li><li>2. Eject the disk manually by pushing an opened paper clip into the hole under the drive slot.</li><li>3. Replace the drive mechanism.</li></ol>
The disk ejects while booting; display shows Mac icon with blinking "X"	<ol style="list-style-type: none"><li>1. Try a known-good system disk.</li><li>2. If the computer is a Macintosh Quadra 900/950, verify that the keyswitch is in the "on" position.</li><li>3. Verify that the trackball or mouse button is not stuck.</li><li>4. Check the internal floppy drive cable connections. If they are secure, replace the internal floppy drive cable.</li><li>5. Replace the drive mechanism.</li></ol>
The disk continuously ejects in a Mac Plus	<ol style="list-style-type: none"><li>1. Verify the internal cable is correct (590-0437, yellow stripe).</li><li>2. Replace the drive mechanism.</li></ol>
Audio and video present, but internal drive does not operate	<ol style="list-style-type: none"><li>1. Try a known-good disk.</li><li>2. Clean the drive. If the drive is a SuperDrive, install a dust shield on the clean drive before reinstalling it.</li><li>3. Check the internal floppy drive cable connections. If they are secure, replace the internal floppy drive cable.</li><li>4. Replace the drive mechanism.</li></ol>

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Drive will read but not write	<ol style="list-style-type: none"> <li>Clean the drive. If the drive is a SuperDrive, install a dust shield on the clean drive before reinstalling it.</li> <li>Check the internal floppy drive cable connections. If they are secure, replace the internal floppy drive cable.</li> <li>Replace the drive mechanism.</li> </ol>
Drive is unable to read; many file transfer errors occur	<ol style="list-style-type: none"> <li>Try a known-good disk.</li> <li>Clean the drive. If the drive is a SuperDrive, install a dust shield on the clean drive before reinstalling it.</li> <li>Replace the drive mechanism.</li> </ol>
Disk initialization fails	<ol style="list-style-type: none"> <li>Verify that you are using the proper type of media.</li> <li>Try a known-good disk.</li> <li>If the disk is 800K, upgrade any system software versions earlier than 6.0.5. The 800K INIT is not in earlier software.</li> <li>Clean the drive. If the drive is a SuperDrive, install a dust shield on the clean drive before reinstalling it.</li> <li>Check the internal floppy drive cable connections. If they are secure, replace the internal floppy drive cable.</li> <li>Replace the drive mechanism.</li> </ol>
Drive will read/write to 800K disks but not to HD disks	<ol style="list-style-type: none"> <li>Verify that you are using high-density media.</li> <li>Check that the drive is a high-density drive.</li> <li>If the CPU is a Mac SE or Mac II, verify that you have the proper ROMs and SWIM chip installed (see Macintosh SE/II SuperDrive upgrade procedures later in this chapter).</li> <li>Replace the drive mechanism.</li> </ol>
MS-DOS drive does not recognize a disk formatted on a 1.4 MB floppy drive	<ol style="list-style-type: none"> <li>Verify that you are using the proper type of media.</li> <li>Try formatting the disk on the MS-DOS computer.</li> <li>Reference the <i>Apple File Exchange User's Guide</i>.</li> <li>Reference the MS-DOS user's guide.</li> </ol>
<b>External Floppy Drive Problems*</b>	<b>Solutions</b>
Drive functions but LED does not light	<ol style="list-style-type: none"> <li>Replace LED assembly.</li> <li>Replace drive mechanism.</li> </ol>
Drive will not read but LED comes on	<ol style="list-style-type: none"> <li>Check software on a known-good system.</li> <li>Replace drive mechanism.</li> </ol>
Drive will not come on; LED flashes once or does not light	<ol style="list-style-type: none"> <li>Check external drive cable connections. If they are secure, replace external drive cable.</li> <li>Replace LED assembly.</li> <li>Replace drive mechanism.</li> </ol>

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\* The HDI-20 external floppy drive does not have an LED.

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## Additional Procedures

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### Cleaning Floppy Drives

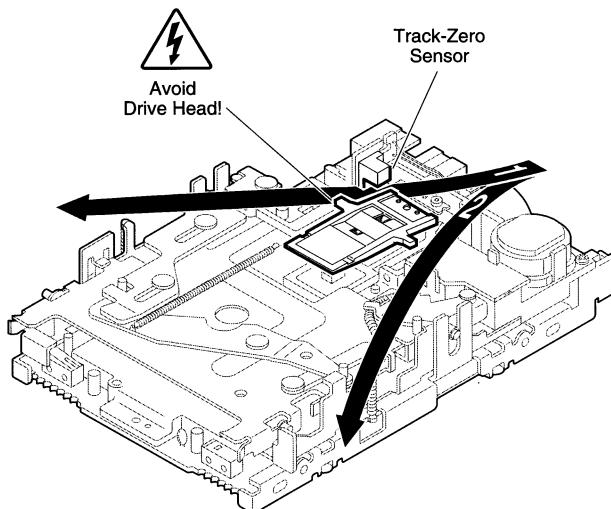
To clean a floppy drive, use the 3M 3.5-Inch Head Cleaning Diskette Kit (model 40263) and follow the directions enclosed in the kit. Do not attempt to clean the floppy drive in any other manner. You could damage the drive.

**Note**

When cleaning products other than the 400K drive found in the 128K and 512K Macintosh, it is important to remove and discard the plastic film tab from the head access slot of the cleaning disk.

FIGURE 5. If the floppy drive is a SuperDrive with considerable dust build-up, remove the drive mechanism from the carrier and use a moisture-free "canned air" product to blow the dust out of the drive mechanism as shown in the figure below. Be sure to clear the track-zero sensor when spraying. This sensor must be kept clear of dust for the drive to function properly.

**▲ Caution** **Never point the spray directly at the drive head. Spraying the head could damage the head gimble.**



**Figure 5 Airflow for Cleaning the 1.4 MB Floppy Drive**

---

## Avoiding Disk Ejection Problems

To avoid disk ejection problems:

- Avoid placing more than two labels on a disk.
- Make sure another disk is not already in the drive.
- Press disks gently into the drive.
- Inspect the internal mounting bracket before installation. A warped or bent mounting bracket will not align with the bezel and can cause disk ejection problems.
- During installation, make sure the disk opening of the drive mechanism is centered in the bezel. If the disk opening is not centered, binding or friction may cause disk ejection problems.

---

## Removing Disks That Will Not Eject

1. Push the disk back in and try to eject it electronically:
  - a. Hold down the <shift> and <command> keys and press 1 (for internal drives) or 2 (for external drives).
  - b. Pull down the File menu and select **Eject**. (Repeat several times.)
2. If the procedures in step 1 do not work, insert a straightened paper clip into the hole located beside the disk insertion slot. Allow the drive to push the disk out. Do **NOT** try to pull the disk out.

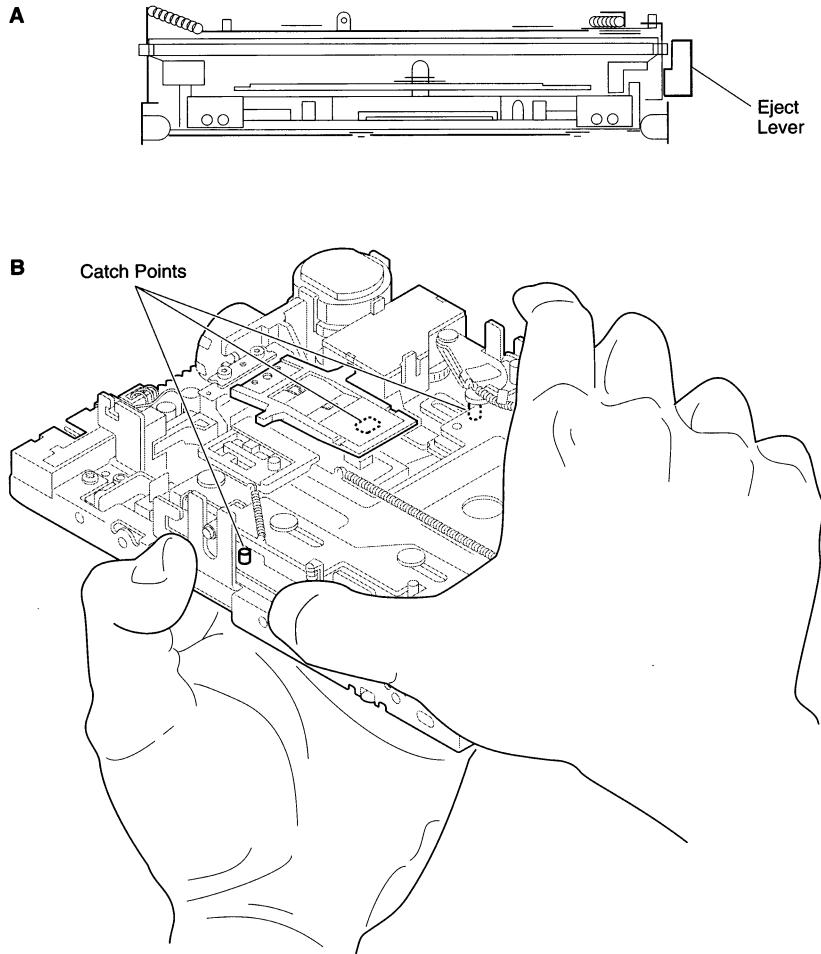
**▲ Caution**

**Pulling a disk forcefully from a drive may damage the drive mechanism.**

3. If the procedure in step 2 does not work, remove the floppy drive and place the drive and carrier assembly upside down.
4. Remove the four screws that hold the drive to the carrier, and remove the drive.
5. FIGURE 6A. Place the drive with the controller board face down and the disk opening facing you. Press the eject lever.
6. FIGURE 6B. If the procedure in step 5 does not work, hold the drive as shown in the figure. Gently pull up on the top of the drive mechanism to free the disk from any

---

points that might catch on the bottom of the drive assembly. Check the three most likely catch points (shown in the graphic). Carefully free the disk from the catch point (head, lever, etc.) and eject the disk with the eject lever.



**Figure 6** Removing Disks That Will Not Eject

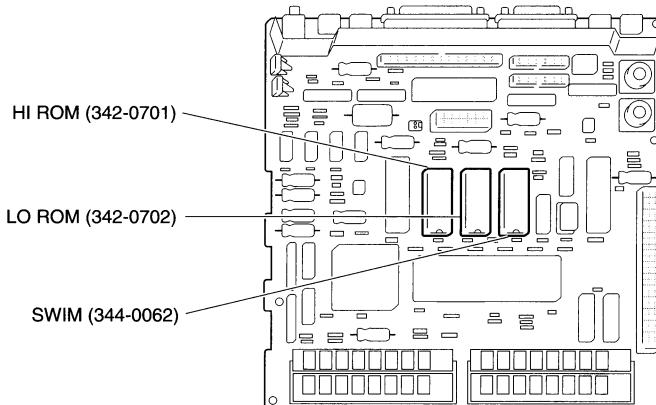
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## **Macintosh SE SuperDrive Upgrade**

Use system software version 6.0.8 or higher with the 1.4 MB SuperDrive. Some earlier software will recognize the drive only as an 800K mechanism.

### **Upgrade Procedure**

1. Remove the cover and discharge the CRT.
2. Using a grounded workstation, remove the video board, SCSI hard drive or upper floppy drive, the main logic board, and the lower floppy drive.
3. FIGURE 7. Using the IC extractor, remove the IWM chip and the two ROM chips from the logic board.
4. FIGURE 7. Install the SWIM chip and the two new ROMs as indicated in the figure. The notch at the end of each SWIM chip and ROM should face the front of the logic board.
5. Install the SuperDrive in the lower internal drive slot.
6. Replace the main logic board; the SCSI hard drive, upper 800K drive, or second SuperDrive; the video board; and the cover.



**Figure 7 Upgrading the Macintosh SE Logic Board**

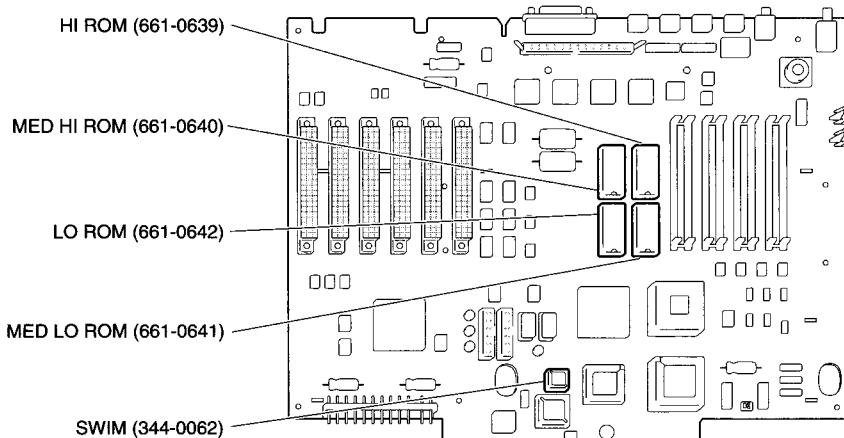
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## Macintosh II SuperDrive Upgrade

Use system software version 6.0.8 or higher with the 1.4 MB SuperDrive. Some earlier software will recognize the drive only as an 800K mechanism.

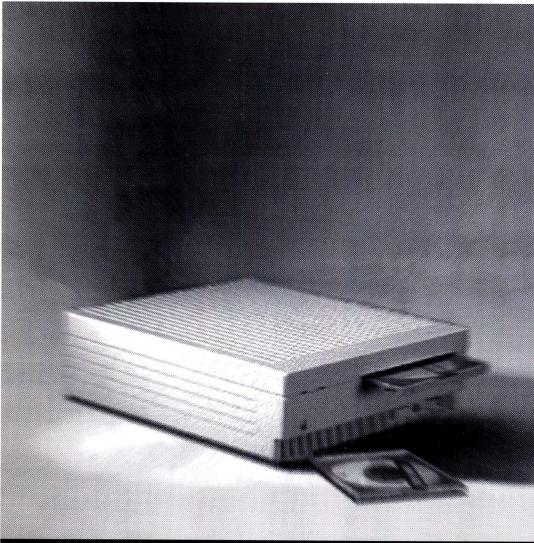
### Upgrade Procedure

1. Using a grounded workstation, remove the top cover, video card (and other installed cards), and drive mount.
2. FIGURE 8. Using an IC extractor, remove the four ROMs at the logic board locations shown in the figure.
3. FIGURE 8. Install the four 512K ROMs as shown in the figure. The notch at the end of each ROM should face the front of the logic board.
4. FIGURE 8. Using the IWM/SWIM extractor (076-0341), remove the IWM chip from the logic board.
5. Position the SWIM chip on the logic board socket so that the beveled edge of the chip is facing the white dot on the logic board.
6. Install the SuperDrive on the the drive mount in drive slot 1 or 2.
7. Replace the drive mount, video card (and any other cards that you removed), and the top cover.



**Figure 8 Upgrading the Macintosh II Logic Board**





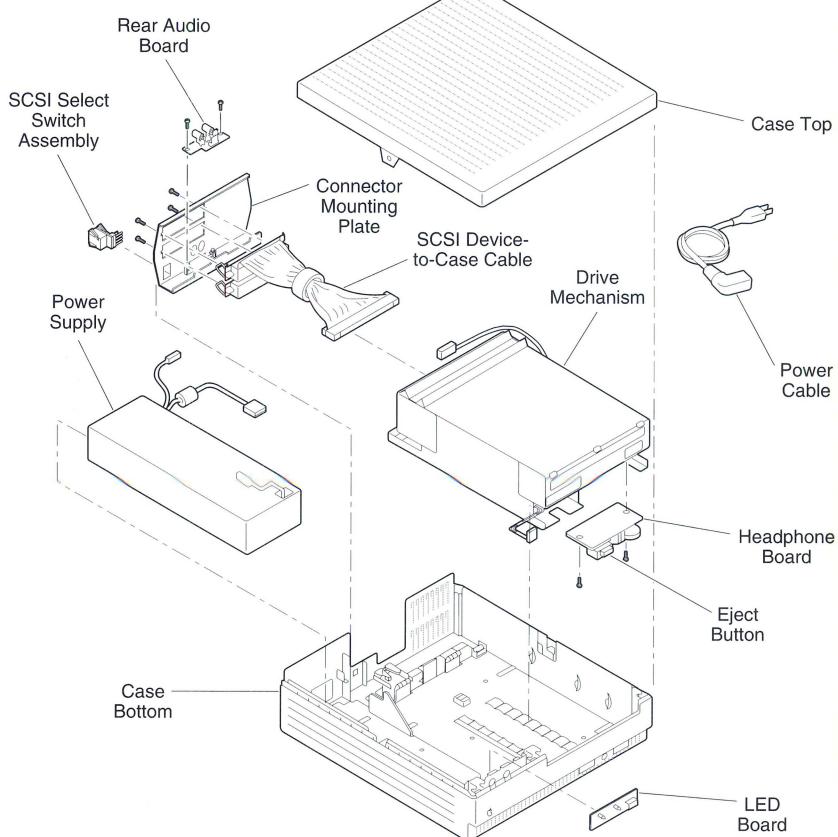
## CD-ROM Drives

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## Illustrated Parts List

A



B

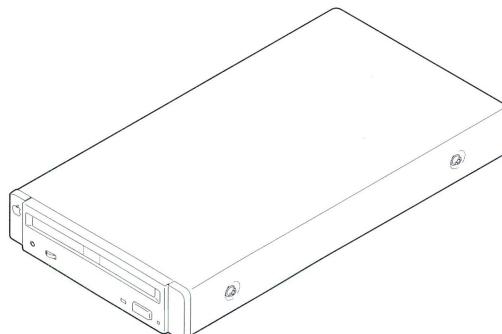


Figure 1 Apple CD-ROM Drives

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### **AppleCD SC (Figure 1A)**

Cables	
Power cable, smoke .....	590-0380
SCSI device-to-case cable .....	590-0235
Case parts	
Case bottom .....	630-5377
Case top .....	630-5376
Connector mounting plate .....	805-0382
Drive mechanism .....	661-0110
Power supply .....	661-0343
Printed circuit boards	
Headphone board.....	982-0020
LED board .....	630-4173
Rear audio board .....	630-4166
Switches and buttons	
Eject button .....	956-0021
SCSI select switch assembly .....	705-0045

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### **AppleCD SC Plus (Figure 1A)**

Cables	
Power cable, smoke .....	590-0380
SCSI device-to-case cable .....	590-0264
Case parts	
Case bottom .....	630-5377
Case top .....	630-5376
Connector mounting plate .....	805-0382
Drive mechanism .....	661-0671
Power supply .....	661-0343
Printed circuit boards	
Headphone board.....	982-0107
LED board .....	630-4173
Rear audio board .....	630-4166
SCSI select switch assembly .....	705-0045

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### **AppleCD 150 Drive and AppleCD 300 Drive (Figure 1B)**

AppleCD 150 (whole-unit-exchange module).....	661-1645
AppleCD 300 mechanism .....	661-1646

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## Troubleshooting

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### Troubleshooting Checklist

The following checklist is a general troubleshooting guide. For specific problems, use the Symptom/Cure Chart. When troubleshooting CD-ROM drives, use known-good system software.

- Verify that all external cable connections are secure.
- Check that every device on the SCSI chain has a unique SCSI ID.
- Verify that the SCSI chain is properly terminated.
- Check that you are using Apple SCSI cables.
- Check all CD-ROM internal cable connections.
- Verify that the power supply is good.
- If the CD-ROM drive is not the only device on the SCSI chain, test the CD-ROM individually with a known-good computer.
- Using the diagnostic or TechStep, verify that the drive mechanism is good.
- If the CD-ROM drive is the AppleCD™ SC, disconnect the fan (see Disconnecting the AppleCD SC® Fan later in this chapter).

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### Symptom/Cure Chart

Problems	Solutions
Green power light is not on	<ol style="list-style-type: none"><li>1. Check that the power cable connections are tight.</li><li>2. Replace the power cable.</li><li>3. Replace the LED board.</li><li>4. Replace the power supply.</li><li>5. Replace the drive mechanism.</li></ol>
Computer can not see the CD-ROM drive	<ol style="list-style-type: none"><li>1. Verify that the CD-ROM was powered on before the computer.</li><li>2. Check the SCSI cable connections.</li><li>3. Check that the CD-ROM has a unique SCSI ID.</li><li>4. Verify that the software for both the computer and the CD-ROM was installed correctly (e.g., the system software and the CD-ROM driver).</li><li>5. Test the CD-ROM with a known-good computer. If the CD-ROM works, the problem could be the computer (bad SCSI port, etc.) or the SCSI chain (see the SCSI General Information chapter).</li><li>6. Replace the SCSI device-to-case cable.</li><li>7. Replace the drive mechanism.</li></ol>
CD-ROM drive will not accept a compact disc	<ol style="list-style-type: none"><li>1. Try a known-good disc.</li><li>2. Try a known-good CD caddy.</li><li>3. Clean the drive mechanism.</li><li>4. Replace the drive mechanism.</li></ol>

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CD-ROM drive has intermittent read/play problems	<ol style="list-style-type: none"> <li>1. Verify that the disc is good.</li> <li>2. Clean the drive mechanism.</li> <li>3. If the unit is an AppleCD SC, disconnect the fan (See Disconnecting the AppleCD SC Fan later in this chapter.)</li> <li>4. Replace the drive mechanism.</li> </ol>
Red LED does not light when the caddy is inserted	<ol style="list-style-type: none"> <li>1. Check that the LED board connection is tight.</li> <li>2. Replace the LED board.</li> <li>3. Replace the drive mechanism.</li> </ol>
Headphone jack does not operate correctly	<ol style="list-style-type: none"> <li>1. Check that the headphone board connection is tight.</li> <li>2. Test the headphones with another system.</li> <li>3. Replace the headphone board.</li> <li>4. Replace the drive mechanism.</li> </ol>
Volume control does not operate correctly	<ol style="list-style-type: none"> <li>1. Check that the headphone board connection is tight.</li> <li>2. Replace the headphone board.</li> <li>3. Replace the drive mechanism.</li> </ol>
Speaker jacks do not operate	<ol style="list-style-type: none"> <li>1. Check that the rear audio board connection is tight.</li> <li>2. Replace the rear audio board.</li> <li>3. Replace the drive mechanism.</li> </ol>

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### ***MacTest Pro***

Use the following procedure to run *MacTest Pro*.

1. Connect the CD-ROM drive to the SCSI port on the rear of a known-good Macintosh computer.
2. Switch on the external CD-ROM drive.
3. Boot the *MacTest Pro* diagnostic disk on the computer and insert the *Sony CD-ROM Test Disc type 2.0\** into the CD-ROM drive.
4. Select the test(s) that you want to run.

**Note** If you select the audio test, you must listen through headphones to determine if music is playing through the headphone jack and that the volume control is working.

5. Click **OK** and then **Test**.

**Important** Do not eject the test disc while *MacTest Pro* is running. If you eject the test disc, *MacTest Pro* will give you a "test failed" result regardless of the true status of the CD-ROM drive.

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\* To function properly, *MacTest Pro* requires the *Sony CD-ROM Test Disc type 2.0*.

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## Disconnecting the AppleCD SC Fan

AppleCD SC drives are susceptible to optical lens assembly contamination because dust and other airborne particles are drawn into the unit by the fan. Disconnecting or removing the fan helps prevent optical lens assembly contamination. This procedure is recommended for all AppleCD SC units.

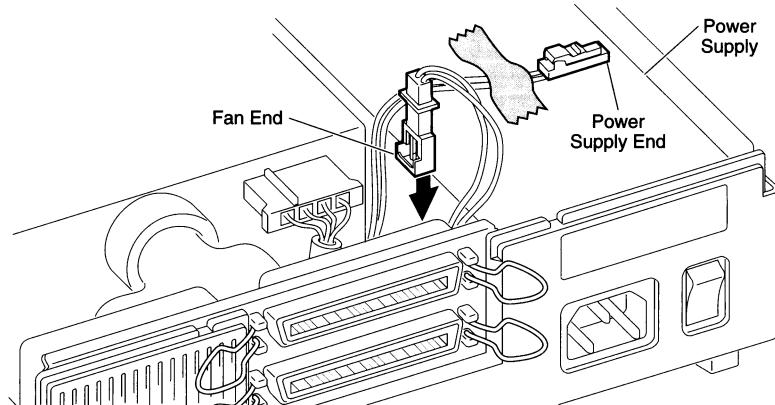
**▲ Caution** **Once you have disconnected the fan, do not put anything on top of the CD-ROM drive. The CD-ROM has cooling vents in the top of the unit that must be kept clear to prevent the unit from overheating.**

### Materials Required

Small flat-blade screwdriver  
Small Phillips screwdriver  
Tape

Follow the steps below to disconnect the AppleCD SC fan.

1. Working on a grounded workstation, remove the case top.
2. Disconnect the fan cable.
3. FIGURE 2. Tape the power-supply end of the fan cable to the top of the power supply.
4. FIGURE 2. Tuck the fan-end of the fan cable into the space in front of the fan.



**Figure 2 Disconnecting the AppleCD SC Fan**

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